THE

# ELECTRICAL REVIEW.

VOL. XLII. FEBRUARY 11, 1898. No. 1,055.

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THE

UNIVERSAL ELECTRICAL DIRECTORY

1898

Edition

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4, LUDGATE HILL, LONDON, E.C.

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Telegraphic Address: "AGENKAY, LONDON." Code A B C.

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## THE RELATIONS BETWEEN CUSTOMER, ENGINEER, AND MANUFACTURER.

THE above is the title of a recent paper presented before the New York Electrical Society by Mr. S. W. Greene. There is some sound sense in this paper. We read that "many consulting engineers, especially those who have recently commenced practice, seem to think that it is improper for them to consult with the manufacturer, or to examine his plant or to ask him for information or advice." The inevitable result is, that specifications often contain provisions which are a source of annoyance and expense to the manufacturer and purchaser alike, and which have no compensating advantages from either the engineering or the commercial standpoint. "Some of the provisions are impossible or impracticable, and the contractor has the awkward task of asking for this modification." These remarks apply to all trades, and to none more than to trades of special character. There are many contractors who, if they pay proper attention to their business, must inevitably become the best experts, and if they be also engineers, it is difficult for any outside consulting engineer to draw up a specification that will meet the views of the experts, unless the consulting engineer has taken the trouble to first place himself in communication with them.

Some of the worst faults in the drawing up of a specification with the form of tender and schedule of prices, are the adherence to old and abandoned methods, the specifying of materials, to make which or obtain from foundries, &c., will require more time than is given for the completion of the contract, whereas better goods of modern commercial sizes are, perhaps, to be had direct from stock for less money. Then the schedule of prices is often drawn up in what is evidently absolute ignorance of the conditions and necessities of carrying out work, and as a fixed printed form is insisted upon, the contractor cannot place his corrections upon it, and the result is, that what should be a good job proves to be dear and bad. We might take the majority of specifications issued within rifle shot of Westminster Hall, and none of them would pass the judgment of a sound practical builder, contractor, engine manufacturer, or other experienced man in each particular kind of work specified. Now all this is decidedly unfair to purchasers. Why should a man who wishes to have certain work done for him pay a 5 per cent. commission to some engineer to specify things which will cost 50 per cent. more, and be twice as difficult to repair as the plant that he could have bought direct from some good firm of contractors. It is because there are shoddy firms that consulting engineers are needful as go betweens, but this is no reason for the too prevailing egotism that disfigures so much of our English work. Mr. Greene finds the same to prevail largely in America, where special apparatus or methods are called for to the exclusion of standard apparatus of equal efficiency. His idea of the consulting engineer is, that his place is to see that his client selects the

best system, and purchases good materials, and the engineer's business is to see he gets them, and he should, therefore, consult with manufacturers, should visit their establishments, and keep himself up to their practice. This, he thinks, no manufacturer would refuse. We should think manufacturers would be glad to keep engineers posted up in view of the chance of having to fill the specifications of these same men at any time, and there is now no mystery in manufacturing that need demand closed doors. On the question of standardising, there is too little done in England. Many things are standardised in America, and great benefit results, especially in railway work. English engineers are perhaps too desirous of making some special mark. Thus, if a railway has worked for years on certain patterns of locomotives, and is working as economically as any other railway, is it not a gross injustice to all concerned that a new locomotive superintendent should hastily alter everything, so as to be able to put his mark on the engines until the rolling stock has as many patterns as there have been superintendents? There must be progress, but a large amount of specified work we constantly meet has not even the merit of being a step forward. It is too often a step backwards into methods properly abandoned by better informed men. Naturally, in the early days of the electrical industry, the types of apparatus have been legion, but then we had not got out of the area of experimentation. Yet there are men in practice who will get up a drawing and a specification for a 20-H.P. steam engine, or for a Lancashire boiler, about which he knows less than the office boy in the boiler-maker's works. Our author points out that some specifications not only specify the conditions of service, the apparatus required, and the tests which will be applied, all which is quite proper, but they specify how the contractor shall make it, which is another.

We all know that he is right. Only a few days ago we saw some general work specified for, which went so far as to specify and show a drawing of certain plummer blocks which were inferior to what any manufacturer of shafting and mill-gearing specialties supplies in his ordinary run of standard work at half the cost these particular new designs would involve.

Many consulting engineers seem to think they ought to supply designs for their clients throughout. Never was a greater mistake made. It is their business to avoid this as much as possible, because the fewer the drawings the cheaper the cost—standard articles being purchased. It is unfortunate there should be so much payment of engineers by commission on cost. The better the engineer does his duty the less he is paid by that system, which we have heard more than once stated to be responsible for the outlay of thousands of pounds where hundreds would suffice. Manufacturers are themselves responsible for much evil. Pick up a manufacturer's catalogues, and how much information will they afford?

Take the above-named item for plummer blocks, and there is found the diameter of the bore and the price, but not a figure as to the length of bearing, the bolt centres, sole length, or breadth, or height of centre. The catalogue is useless, as compared with a German book before us, which gives every detail, so that, by its aid, a scheme of machinery becomes merely the suitable arrangement of certain standards. The truth is, we are to-day, in the commonest articles of engineers' use, in much the same condition as we were before Whitworth standardised the screw thread. The only difference is the screw thread. Everything else is much as it was. English manufacturers ought to look to this. They pay far too little attention to either standardising, as between each other, or making their own goods interchangeable. Pipe makers are grievous sinners in this respect, and of all people, they ought to follow standard sizes and interchangeableness. It is the same with makers of rolled girders, who again fall lamentably behind the American mills, in not providing suitable catalogues, with weights and all other properties of their sections.

Finally, the powers taken by engineers in their specifications to harass contractors ought to be more limited. Every contractor knows the constant trouble which arises, no matter how good his work, because of some busybody of an underling who is continually finding fault and hindering progress, too often for the sake of really spoiling what he is professing to improve. When the engineer is devoid of practical knowledge he is sure to take the part of his man, who is, perhaps, acting as clerk of works, against the word of the more experienced contractor, who is, of course, tainted because he is supposed to be making money out of his work, and must be prevented doing so at all costs.

We take it that the principal duty of a consulting engineer is, or should be, to use a practical knowledge, acquired in a contractor's works, in advising his non-technical client what to purchase from contractors. In the end, it is the contractors who make and employ their own special experts to design. Can a consulting engineer get out plans from steam boilers to incandescent lamps that can compare in any one item with the work of the dozen engineer experts who devote themselves the one to boilers, the other to engines, the third to the dynamo, and so on? Yet this is what we seem to find is the motive underlying most specifications. The system cannot even be claimed good for trade, for it runs up expense and chokes off progress, and the engineer himself is worse off, for he gets his commission probably on a single job costing, say £2,000, where otherwise he might have drawn on two or more jobs at £1,500 each, had an easier time of it, and given better satisfaction.

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**A Difficulty in Electric Traction.**—If one pair of wheels in an electric locomotive combined in series should happen, from any cause, to slip, its high speed of rotation will set up so much counter E.M.F. that the current will be checked and torque reduced, and this will happen to every wheel in a series combination. Coupling rods to check the tendency of one wheel to slip are undesirable additions to an electric as to any other locomotive. As series working is very usual at times of starting, a single greasy spot on the rail might destroy the tractive force of the whole machine. One of the most promising systems of control is stated by the *Electrical World* to be the Leonard system, using separately excited motors with fully-saturated fields in starting, and with armatures supplied from a motor generator with adjustable secondary voltage. If, then, any one wheel slips its torque will be reduced and slipping will stop, but the remainder of the wheels will be unaffected, and as electrical locomotives are not overweighted for tractive purposes, the additional mechanism will be an advantage than otherwise. For yard purposes the electrical locomotive is extolled. It can be run into sheds without risk of dirt, smoke, or fire. It is also quieter and not so alarming to horses.

## EXPERIMENTS ON INDUCTION AT LONG DISTANCES WITH HIGH FREQUENCY CURRENTS.

In an article in the *Electrical World*, N.Y., by Messrs. Northrup, Pierce and Reichmann, a series of experiments are described in which several novel instruments and methods were made use of.

The receiver employed was a kind of galvanometer for high frequency currents, and indicated approximately the maximum value of the current in the receiving circuit by the deflection of a copper disc suspended by a quartz fibre inside a coil. The copper or silver disc is set at an angle of 45° to the plane of the coil, and when an alternating current is sent through the latter, currents are induced in the disc which tend to twist it into the plane of the coil.

Considering the importance which the study of high frequency currents has recently acquired, some details as to the construction of this detector may be worth giving, and we therefore quote the description given by the authors:

"The delicacy of these instruments was due to the use of fine quartz fibres for suspension, and rapid damping was obtained by placing the disc between the poles of a permanent magnet. Any motion of the disc generated currents in it which brought it back to rest. Some details regarding the construction of these instruments are worthy of note, since care and experience in these details can alone make the instrument delicate and serviceable. The deflections were read by means of a telescope and scale. The complete period of the first instrument was 16 seconds, and that of the second was 13½ seconds. In the first instrument the system consisted of a ring of pure silver, with an external diameter of 12 mm. and an internal diameter of 7 mm., mounted upon a fine glass rod, which carried a thin, small mirror just above the coil. In the second instrument a silver disc 6 mm. in diameter was used instead of a ring. The mirror in this instrument was 4 mm. × 7 mm. Such mirrors can readily

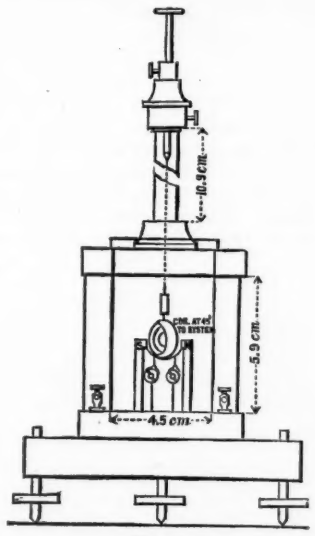


Fig. 1.

be made by silvering ordinary microscopic cover glass. They may be given the desired shape by breaking them in the following manner: The mirror is laid face down upon a hard smooth surface; the edge of a steel rule is placed upon the silvered surface and pressure exerted, when the mirror breaks along the edge of the rule. Since cover glass is extremely thin, using varnish upon the back of the mirror, or mounting it directly with any kind of cement, will distort the glass and give a confused image of the scale. The mounting is best accomplished by first fastening with hot sealing wax a small strip of cover glass to the rod. The surface of this should then be touched with shellac, and the extreme upper edge only of the mirror laid upon it. The greater portion of the mirror is thus unstrained, and a clear scale can be obtained from an extremely light mirror. The coil of the instrument shown in fig. 1 was wound in several layers upon a hard rubber bobbin with very thin walls. Waxed paper was placed between the layers, and the whole coil was soaked in hot beeswax and rosin. This precaution is required to prevent short circuits between the layers. At the top of the coil all the wires made a semi-circular turn, so as to leave a slot in one side of the coil, through which the glass rod bearing the silver ring could pass, thus bringing the axis of rotation of the ring in the centre of the coil. This made the coils detachable. Various coils with different numbers of turns were tried. One which gave satisfactory results, when the frequency of the induced current was comparatively low, contained 104 turns of No. 36 B. & S. wire. The axial depth of the coil may be as great as, but not greater than, the axial distance from one edge to the other of the silver ring or disc, when placed in the coil at an angle of 45°. The ends of the quartz fibre were attached with hot sealing wax.

"It is essential that the silver ring should not come in contact with iron, for since the ring is suspended between the poles of a magnet the attraction upon the ring due to the presence of iron may greatly decrease the sensitiveness of the instrument. On the other hand, the silver may be found dia-magnetic, in which case the system, when brought by the torsion of the fibre into the right position, may be found to be unstable. This difficulty may be overcome by brushing the silver disc with a weak solution of iron sulphate. A few trials will serve to nullify the action of the magnet on the system."

Using this indicating instrument, the authors made a number of experiments to show the importance of resonance in the two circuits between which the electric waves are being transmitted. In one series of experiments, the inducing circuit A, fig. 2, consisted of a rectangular loop of bell wire,

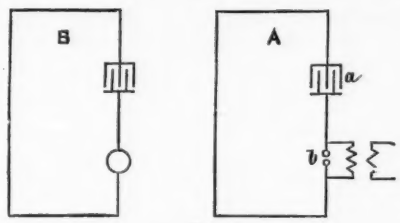


Fig. 2.

the dimensions of which could be varied. A condenser, *a*, of small and variable capacity, and a spark gap, *b*, were inserted in series in the loop. The receiving circuit, B, consisted of a similar loop with a condenser and the indicating instrument in series. The condensers in both circuits were built up of tinfoil and glass plates 18 × 20 inches. Fractional values of the capacity of one pair of plates were obtained by folding back the upper tinfoil sheet a known amount. The spark gap consisted of two brass balls, about 2 cm. in diameter, their separation being effected by means of a micrometer screw.

In experiments on the production of electric waves, it is important that energy should be supplied to the radiator continuously during the period when the indicating instrument in the receiving instrument is deflecting. Since an induction coil or an influence machine supplies energy only for a time, which is short compared with the intervals between each discharge, it is evident that the maximum amount of radiation cannot be obtained by the use of such sources of current. To obtain the best effects a source of current should be employed which will give a continuous discharge across the spark gap. It is further necessary, in order that oscillations may occur in the circuit, that the discharge across the spark gap, should not be of the nature of an arc.

The following simple and effective method of generating a continuous stream of high frequency currents was employed by the authors. The E.M.F. of the alternating 100-volt city circuit was raised to the required amount by means of a high potential transformer. The terminals of the secondary were directly connected to the opposite sides of the spark gap, *b*, fig. 2, and the primary to the city

circuit terminals, through a variable inductive resistance. Arcing was prevented at the spark gap by a strong blast of air supplied by a foot bellows. Without this air blast to blow out the arc only very feeble oscillations occur, and practically no induction effects could be obtained; but, with it the oscillations are strong and continuous. It is unnecessary with this arrangement to keep the balls bright and polished. Moreover, the effects obtained can be made extremely uniform if we insert in series with the secondary of the coil a condenser of such capacity that the arc between the balls ceases to have a flaming character.

The experiments with the above described apparatus verified, in a very striking and simple manner, the importance of resonance and high frequency in the effective transmission of inductive effects. The authors deduce by an elaborate mathematical investigation, a formula for the deflection of their high frequency galvanometer. This formula is somewhat complicated and contains many factors. It indicates that the deflection is inversely proportional to the sixth power of the distance between the radiator and receiver, so that this style of apparatus is not very suitable for wireless telegraphy to long distances. Indeed, the authors estimate that signals could not be transmitted over a greater distance than 1,600 feet with the best arrangements of their wire loop apparatus. These experiments are, however, of considerable scientific interest, and the methods described of generating and detecting electrical oscillations appear to possess some novelty, and to have considerable practical value.

## COMPARATIVE COST OF STEAM AND ELECTRIC POWER.

II.

Though perhaps less convenient than electric transmission, mechanical methods may, if well designed, be more economical where the load factor throughout the year is high. But a large class of power users make such variable demands for power that the ratio of average to maximum is very small. Such conditions favour electricity both as a power transmitter and as a prime mover in that particular place. Illustrative of the first case is taken an engine of 1,000 H.P., delivering 750 H.P. to machinery and 250 H.P. to power transmitters. But if the load factor be 35 per cent. only—not a specially small factor—the useful work will be only 28·6 per cent. But electrical transmission would give the same total efficiency of 75 per cent. from engine pulley to machinery, and for a load factor of 35 per cent. the total efficiency would be 50 to 60 per cent., or double that for mechanical transmission. Thus, while the total power would be the same and the 1,000 H.P. engine would be retained, coal would be saved to the extent of 30 to 40 per cent., which with coal at 12s. would mean £400 to £600 per year in a non-condensing plant.

In particular cases the main plant could be reduced by at least a fourth with all that this implies of saving.

If at full load the constant charges are £1,000 a year, and the same figure stand also for the variable charges, the variable charges will remain about constant per H.P.-hour. If the load factor becomes 50 per cent., the constant charges remain the same, and the variable charges become halved.

At half a million H.P.-hours annually, the constant charges will be 1 cent per hour, and the variable charges also 1 cent. With only a quarter million H.P.-hours annually, the constant charges will become 2 cents per H.P.-hour, the variable charges being, as before, 1 cent. The total full load cost is thus 2 cents, as against 3 cents when the load factor is 50 per cent.

Hence the total costs must, for economy, be chiefly a summation of variable costs. Constant charges on plant become higher, out of all proportion, as steam engines become smaller. This is a well recognised fact. One man can attend to a 200-H.P. plant. In smaller shops either one man must attend to the small boiler and engine of 2 H.P., or they must be left to anyone, and there is an enormous but not directly visible waste. Central station working has the advantage of a better average load than any individual consumer, but there is the disadvantage of the costly system of mains, and these have proved fatal to central station power distribution, except for small consumers who have been willing to pay as high as 20 cents per H.P. hour. This, of course, applies to steam distribution. Electricity steps in here, and proves capable of transmitting power economically to scattered consumers, and this apart from its higher efficiency for distribution. Much of this arises from the ability of distributing two energies over one main, viz., lighting energy and power energy, both generated by the same machinery. As in a large station the variable charges are small on all loads which do not "peak," a small charge for power brings in a handsome return. With special bids thus possible for consumers of electrical power, it would seem impossible for small isolated steam powers to compete with electrical. This is Mr. Taylor's conclusion, and it should be the province of our English companies to look for customers among the small shops. We have some knowledge of the power consumed by small shops, and we are convinced there is a huge opening. We are also convinced that makers of small motors should lay themselves out to answer a few plain questions as to cost and power. At present the fashion seems to be to tell nothing. Surely there has by this time accumulated sufficient data as to the use of current by a lathe, a drill, or a fan to enable a rough estimate to be given.

The power absorption by machinery has always been a little known subject, but this is largely because the absorption by the machine has been complicated by the question of shafting. With electricity, it would be so very easy to know just how much a 9-inch lathe consumes idle, or cutting, that we wonder no one who has the opportunity has found this out and made a list of a few sizes of tools and their various power absorption. Such a table would, we feel sure, greatly facilitate business.

(*To be continued.*)

## SOME NOTES ON SINGLE-PHASE MOTORS.

By A. C. Eborall.

(*Continued from page* 137.)

*The Stator.*—The stator of modern motors is always built up of lightly insulated soft iron core discs, these, as shown in fig. 7 (A, B, C), being either slotted, or pierced with rectangular or semi-rectangular holes for the reception of the windings. Fig. 7A is Messrs. Brown, Boveri & Co.'s construction, fig. 7B that of the Oerlikon Company, and fig. 7C that of

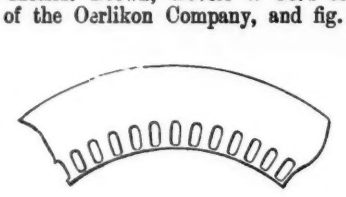

Fig. 7A.

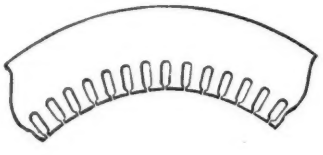

Fig. 7B.

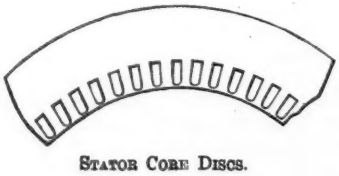

Fig. 7C.

Stator Core Discs.

Messrs. Kolben & Co. Whichever construction is used, the apertures in the iron must be punched very near the inner edge, or else there may be considerable leakage across the

small iron bridges or air-gap. In practice, the distance of the hole from the internal periphery of the stator is rarely more than 3 millimetres in the largest motors, and is a mere shred of iron in the small ones. If the stator is of large size, the core discs are punched out in sections, these sections being afterwards bolted up together, the joints in one layer being covered up by the next.

The depth of the hole or slot varies in practice from $1\frac{1}{2}$ to 3 times its width; it should be as small as possible, as leakage increases with the depth of winding. The distance between each hole or slot is a little more than the width, there being preferably many small slots or holes rather than fewer large ones, as these would tend to destroy the evenness of the field, and might cause heating of the rotor.

The advantages of thus imbedding the windings (first introduced by Mr. C. E. L. Brown) are several. For example, the weight output is increased, the magnetic resistance is reduced to a minimum (and hence a smaller magnetising current is required, and larger power factor results), and all eddy currents in the stator windings are prevented. Further, if the motor windings are also embedded, as in practice is the case, the air-gap need only be large enough to give the necessary mechanical clearance, the strain comes on the iron, not on the windings, and both rotor and stator are smooth all round.

As to which is the better, the hole or slot, probably, taking them all round, there is not much to choose between them. The pole produced by hole winding is more even than that produced by slots, but owing to the absence of the small iron bridges, there is probably a little less leakage with the latter. Messrs. Kolben's semi-rectangular hole has more winding space than either of the other two, and gives a very even pole.

The next thing to consider is the winding. The speed of the motor, and the frequency of supply being known, the number of poles is given by

$$p = \frac{120 \times \text{frequency}}{\text{revolutions per minute}}$$

as already pointed out. They may be produced by either a ring or drum winding; but some form of the latter is invariably used, and is far the best. Ring winding has several disadvantages—its magnetic leakage is greater; it requires more wire for the same effect, and, moreover, precludes the use of an iron case for holding up the stator core discs on account of the leakage that would be produced through it. The bad effect of leakage on the starting and power factor of a single-phaser have already been pointed out.

Fig. 8 shows diagrammatically the form of drum winding introduced by Messrs. Brown, Boveri & Co., and now

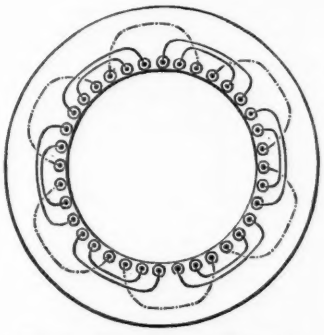

Fig. 8.—Stator Drum Winding.

invariably used on the Continent for all kinds of induction motors. The dotted lines indicate the starting winding. In practice, each coil of the working winding is wound quite straight, its shape being a simple rectangle, while the coils of the starting winding are bent up and over the others. It is usual to wind about two-thirds of the holes with the coils of the working winding, the starting winding consisting of equal ampere-turns of thinner wire, as it is only in use for a short time. The number of turns on the starting winding depends, however, on the nature of the starting device employed, as will be seen later.

*The Rotor.*—Rotors for single-phase motors may be of two kinds: a simple short-circuited bar winding, or a three-phase bar winding, whose ends are joined to slip-rings on the shaft and between which may be inserted resistances, used as a rule only during the starting of the motor, and whose function will be discussed later.

If the rotor is of the first form, it is built up of core discs of the shape shown in fig. 9A, each stamping being lightly insu-

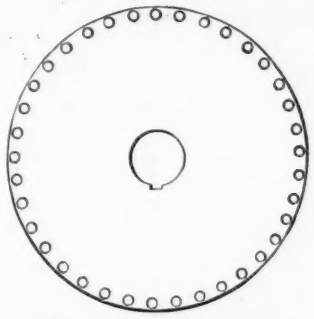

Fig. 9A.—Rotor Core Disc.

lated from its neighbour, and the two end plates being made considerably stouter than the rest for the sake of stiffening the rotor. Three or more bolts are generally passed through from end to end, and parallel to the shaft, for the same purpose. Through the holes in the core discs copper bars are passed through, the bars being insulated by paper or other material from the iron. The copper bars are short-circuited at each end by means of copper rings, the section of these rings, for a reason presently to be explained, being considerably less than the total section of the bars.

The reason for insulating the rotor bars at all is simply to fulfil one of the conditions previously enumerated as to confining the rotor currents to proper paths. The reason

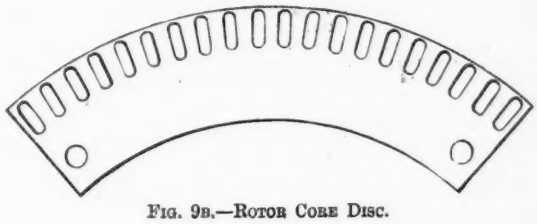

Fig. 9B.—Rotor Core Disc.

for using rings for short-circuiting the bars is partly because they offer a good cooling surface, and partly because by their use over-wrapping at the ends and the use of connectors is avoided, the whole forming a sound mechanical job.

If the rotor has to be of the second form mentioned above, with its windings connected to slip-rings, its construction is somewhat different. As such a rotor is generally of large size, the core discs are built up in sections, as shown in fig. 9B, and owing to the fact that the centre of the iron part of large rotors is inactive, these sections are built up either on a spider, or else on the rim of a fly-wheel, according to the size of the motor.

The number of holes or tunnels is determined by reference to those in the stator, they being always more numerous than those in the latter, and an uneven multiple of them when possible. It follows from this that the rotor holes or tunnels will be longer and narrower than those in the stator.

*(To be continued.)*

## LEGAL.

Salmony & Co. *v.* Improved Electric Glow Lamp Company.

The hearing of the case, the verdict in which was briefly recorded in our last issue, was resumed on Monday last week.

Mr. Max Salmony was cross-examined at considerable length by Mr. Rufus Isaacs, but on the whole bore out his counsel's opening statement as to the agreement arrived at with the defendant company.

Mr. Ernest Rosenberg, also a member of the firm, called by Mr. Tindal Atkinson, gave evidence. He said that at the interview of September 16th, 1887, the defendants accepted their conditions, and an agreement was completed. Mr. Snell, the solicitor, and Mr. Fanta wanted them to guarantee that Mr. Brown, of Eastbourne, and Mr. McLeod, of Glasgow, would accept an assignment of their agencies, but they refused to give it. The invoices were returned by the defendants, but they ultimately agreed to take the goods.

Mr. Rubenstein said there was a discussion as to the £700 alleged profit from the agencies, at a meeting at the Hotel Metropole, but no guarantee, such as was suggested, was given. There was only an offer from Mr. McLeod, but no acceptance of any contract.

His Lordship said the questions seemed to be whether the defendants were entitled to rely on the special agreement which they set up, and to damages because the arrangement with McLeod was not a contract, but only an offer.

Mr. Rufus Isaacs said he would reserve his remarks on behalf of the defendants, and at once call witnesses.

Mr. Ferdinand Fanta said he was managing director of the defendant company, and was also manager of the syndicate before it was transferred to the company. At the interview of March 30th, 1897, when he gave the order for the lamps, he wanted them for the Jubilee. They were to be delivered by May 25th. It was a condition that the lampholders were to be delivered within 8 or 10 days. It was absolutely essential to have the goods some time before the Jubilee, June 3rd or 4th, when they were delivered was not in sufficient time. They were able accidentally to use some of them—some 2,200. He gave instructions to the employés to refuse to take delivery after May 25th, but they were delivered in the absence of the warehouseman. He met Mr. Salmony and Mr. Rosenberg about June 7th or 8th, and told them the goods were useless. As it happened, he was able to use some of them in connection with the illumination of St. James's Street, and plaintiffs agreed that he should do his best to dispose of part of them. He promised to do so. He did what he could, and there was no dispute about the price of those which he used. He never agreed to take the whole of them at the invoice prices. The remainder of the goods in respect of which he had not paid into Court were still on his premises, and could not be used. Plaintiffs told him they would hand over the contracts with Brown and McLeod, which showed £800 or £900 profit, but eventually £700 was agreed upon. He then believed he was getting the contract with McLeod, and the profit, but the company never got a farthing; as a matter of fact, Brown's contract was still in abeyance.

Mr. Tindal Atkinson: What is your complaint with regard to this matter of McLeod's?—Paying £300 for certain contracts, which were represented to us to show £700 profit. We found that no business resulted from it. There was no contract, no sale of anything.

Were you in a position to supply the lamps?—Certainly.

When were you first informed that it was only an offer from McLeod, and that there was no contract?—I found it out when McLeod refused to allow their letters and orders to be assigned to the company without his consent. The syndicate was formed to purchase certain patents and the sale of the lamps in the United Kingdom.

By His Lordship: They expected to get Schwaber's agency.

In further cross-examination, Witness said he thought he had been deceived in the matter of the contracts with McLeod and Brown. The syndicate was formed for the purpose of purchasing certain patents, Schwarber's amongst them. In order to successfully carry out his plans it was necessary that he should obtain the sole agency, which was then in the hands of the plaintiffs, and he had to purchase them out. That was not the principal object he had in view with regard to his agreement with the plaintiffs. In that particular negotiation the principal consideration was that witness would undertake to take delivery of all lamps which Messrs. Salmony might have, not only on their premises but which they might have on their premises six weeks after that date, and it turned out that those amounted to some 10,000 lamps which had been invoiced to them, and which the syndicate agreed to purchase for a higher price than the plaintiffs had paid for them. Witness stated that he never agreed to take the holders in dispute, but would try to dispose of them, acting as the plaintiffs' agents in fact. Witness told Mr. Salmony that if he did succeed in disposing of them, he should require a commission. He did not know that there was any representation as to the commission in the company's books. When the plaintiffs sent the company the invoices, they were returned to them, but re-returned by the plaintiffs to the company. Witness ordered the holders in question for the purpose of using them at the Brussels Exhibition. He told Mr. Salmony that they would not be any use to him unless he could use them for Jubilee Day, and then send them on to Brussels. Witness would have to decide about the Brussels contract in May. Not getting the holders delivered in time, he could not get the contract. As a matter of fact, he did not press for that contract, and it was not accepted.

Mr. Herbert Thompson, book-keeper of the defendant company, gave evidence, generally bearing out that of Mr. Fanta. This evidence closed the defendants' case.

Mr. Rufus Isaacs said the whole question was what was agreed upon between the parties. As to the 25 per cent. commission on the £100, though large, it was not, he contended, exceptional, under the circumstances. Having gone over the correspondence, he contended that the story told by his clients was the most probable one. Under the deed of assignment of the two contracts of McLeod and Brown for £300, he maintained that defendants were entitled to damages for breach of contract. It was said that the counter-claim was a bogus one, and only concocted for the purposes of that case; but nothing could be further from the truth than that assertion, and on that counter claim he was clearly entitled to damages.

Mr. Tindal Atkinson maintained that the counter-claim had been manufactured for the purposes of that trial, and complained that the want of pleadings in the case had materially lengthened the proceedings—a remark with which his Lordship concurred. Plaintiffs denied that they had guaranteed the contracts. The fact was, that McLeod had refused to homologate, and defendants took the risk of that when they made the agreement. He submitted that plaintiffs were entitled to judgment on both the claim and counter-claim.

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His Lordship gave judgment on Tuesday morning. Having briefly gone over the evidence, he said there was no question in his mind that the contract with Mr. Brown, of Eastbourne, was an actual contract, and that the transaction with Mr. McLeod, of Glasgow, was one which might fairly be described as a contract in view. It was a contract in view and not in hand, although there was very little difference between them. Proceeding to deal with the counter-claim of the defendants, he said that if it was found that if a document or agreement had missed conveying what it was intended to convey, it was right and just that the document should be reframed for the purpose of getting at what both sides intended and what was meant. He had no doubt that at the time the agreement was made both the parties understood one thing only, and that was that the benefit of the correspondence and arrangement with Mr. McLeod was to be transferred, whatever it was worth. The defendants had the full benefit of the objection they took, but they did not communicate with McLeod, or try to verify what had been said with regard to him for fully two months. In fact, no question was ever raised until nearly a year later, in any serious form. Not until October 22nd did he find any serious complaint, McLeod had then refused to homologate and to transfer his contracts, and it was only after that that the liquidator of the syndicate, Mr. Bartlett, wrote and drew attention to the fact that the contracts with McLeod and Brown had not resulted in the business and profit which plaintiffs had guaranteed, and that Messrs. McLeod and Brown had repudiated the right of the plaintiffs to hand the contracts over to the syndicate. He repeated that there had never been any proper negotiations with McLeod, and that no claim was made with regard to him for nearly a year. The defendants' solicitors' letters were sufficient to show that what was intended and understood to be given was given and accepted on the terms of the guarantee which was written. He did not see why he should give the defendants damages on the counter-claim, because McLeod had declined to trade with them as the persons to whom his contract with another person had been handed over. Defendants took their risk of that. A. could not assign to B. a contract with C. against the latter's will. The defendants took the risk of McLeod agreeing to the assignment, and McLeod declined. He could not, therefore, give defendants damages on the counter-claim. With regard to the claim, the matter stood thus: In March, 1897, a contract was made for the sale of these goods, which had to be manufactured in Germany and supplied to the present defendants. It was said they were not supplied in a reasonable time, but reasonableness of time must depend upon the circumstances, such as the time necessary to give the orders, to construct the articles, and to bring them to England. It must be a time reasonable to the vendor as well as the purchaser. If April 14th was agreed upon, the order could not have been carried out. When the order was carried out, the defendants contended that delivery was too late, and sent back the invoices, but they afterwards took them back, and did, upon some terms which were not disputed, agree to take and pay for the goods. Therefore the question arose, on what terms and in what fashion did they take them as agents, or did they, when they found they could use a certain number, during the Jubilee, take them? The same could not be said as to the lamps, which were said to have been required for Brussels, as their tender there was refused. There was no sufficient weight of evidence to justify him in saying that any special agreement was come to. There was no trace in the books of any correspondence as to any such agreement, and no form of accounts was kept on that basis. In the face of the conflict of evidence, he must be guided by the letters which passed. It appeared to him that there was no proof that the goods should not be paid for, as they were ultimately accepted, taken into the stores, and used by the defendants. He therefore gave judgment for plaintiffs on the counter-claim and also on the claim, with costs. On the application of Mr. Tindal Atkinson, he made an order for the money paid into Court to be paid out.

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### The House-to-House Electric Light Supply Company.

A petition for the reduction of the capital of this company was sanctioned by Mr. Justice Romer on Saturday. The company was formed in 1888 with an original capital of £350,000, which had been reduced to £200,000. Amongst the shares issued by the company were 100 founders' shares, which it was desired to get rid of, and the general scheme of the petition was that the founders' shares should be surrendered to the company, and that the holders should subscribe for a certain number of ordinary and preference shares which were part of the original capital of the company, leaving the capital at £199,500 instead of £200,000.

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### Brown v. I. E. S. Accumulator Company.

This case came before Mr. Justice Romer, on Saturday, on motion for judgment as a short cause in default of defence. This company was incorporated in 1895 for the purpose of carrying on business as manufacturers of electrical batteries, and the plaintiff was the holder of debentures in respect of which the company made default. A company named New & Mayne were also made defendants, they being interested in the taking of the accounts. Mr. Justice Romer made the usual order in a debenture holder's action.

## CORRESPONDENCE.

### Wireless Telegraphy—A Forecast.

When reading the paragraphs appearing now and again in the lay newspaper, recording a further advancing step towards the solution of the problem of telegraphing without the aid of wires, how many are there who realise the possibilities—the certainties, it can be safely said—meant by its accomplishment? Very few, as few probably as foresaw the results of the experiments of Cooke and Wheatstone, 50 years ago, in telegraphing with wires. The adoption and practical application of the new discovery will, however, be probably far more prompt and decisive than those referred to of half a century back; indeed, it would be hard to find a more significant index of the progress made in that short length of time, than in contrasting the eager readiness with which a new invention is now taken up, with the indifferent treatment it then met. For instance, the big London dailies, probably the most liberal and eager of all concerns in availing themselves of any new thing to their advantage, were about the slowest to see the wonderful possibilities—and, to us, evident gain—of telegraphy. Reuter—a specialist even in pre-telegraphic times, in the rapid transmission of news by means of carrier pigeons—one of the first to realise the full meaning of the new discovery, and to utilise it, failed, month after month, in inducing any of the London papers to accept his reports; and even had, ultimately, to supply a month's reports free, that comparison might be made between them, and those of the "special correspondents" of the existing order, to see if his own were true and reliable. The *Daily Telegraph*, to its credit, was the first to accept the new order of things, being, of course, soon followed, in self-defence, by the others; the *Times* coming, with a due and fitting sense of weight and dignity, at the tail end of the procession.

Telegraphing without the aid of wires is already practicable, granted favourable conditions, at distances up to 20 or 30 miles, and as this is simply the thin end of the wedge, when that wedge shall have been driven home, as in due course it must be, to its full length, by the time the butt end is out of sight, telegraphing from one end of the country to the other will be possible. It requires but little imagination to combine the telephone with the new departure; and we will thus have practicable the power of talking in London as readily to a friend, say, in Edinburgh or Dublin, as though he were sitting the other side of the table. Electric energy having by then also become a household requirement, supplied by each municipality, stored, much as coal now is, in a cellar, and fulfilling in an infinitely more ready and cleanly manner all the present purposes of coal—with a host of others to boot, from rocking a cradle and working a sewing machine, to turning the mangle and closing the front gate—there will be everywhere available a ready margin for telephonic use.

Given this necessary first power, the only other thing needful will be suitable transmitting and receiving instruments, in which will be arranged the essentials to success, of ready adaptation to varying distances and directions, and a means of conveying the particular message to the particular receiver in the hands, or at the ear, of the one it is wished to communicate with. But let an instance be taken of probable use to illustrate the point, a traveller, say, wishes to despatch an order to his wholesale house—he would, of course, be himself unnecessary were it not for the necessity of showing samples of his goods. In his room in the hotel he takes out of its case his small portable transmitter, and attaches it by the stud at the end of a short length of wire to the slot in the wall, connected with the electric reservoir and wires in the basement. By the help of a small attached compass and a map, he next turns the revolving body of the instrument upon its stand until an indicator points exactly in the true direction of the receiver, and then sets a second indicating pin, after consulting a table of distances, to the figure representing his distance from head-quarters. There being little danger of his message getting mixed up amongst the thousands of others travelling in the upper air, as each one will take its own distinct path, like rays of light and heat, the only point now remaining is to arrange that the message will be delivered at the right receiving instrument. This will possibly be accomplished by the setting of some combination of letters and figures arranged beforehand by the two correspondents—in much the same way that a safe can only be opened by one who knows the word, or combination of figures the lock has been set to. These simple preliminaries over, the order is sent away by merely speaking against a vulcanite disc—so many yards of material to so-and-so, or so many tubs of butter to somebody else.

It looks a bit strange at first to us; but would not the prophecy of the possibility of sending a message from London to New York, under the sea, in a few seconds, have seemed equally strange, or stranger, to our fathers? Yet this is a commonplace of to-day; telephonic communication between the two centres is also, probably, on the point of being made possible, so there is, after all, but the thin substance of one wire between what is, practically, accomplished, and that which we regard as so strange.

And what a difference it will make both in the smaller and ordinary, as well as the larger and extraordinary, affairs of life! The smaller possibilities of commerce have been touched upon, but we can go much further afield, and anticipate totally different conditions to present ones, for the markets of the world. The American, Russian or Indian wheat grower will be closely and cheaply in touch, by individual word of mouth, with his English broker; the cotton grower with the Manchester weaver; the iron master with those on the spot selected for the placing of his rails and machinery. The fisherman at sea, with his latitude and longitude accurately worked out, will be able to send his Grimsby or Yarmouth buyer full particulars of the fish in the hold of the trawler under his charge; whilst the mariner in general, in the same easy and ready manner, will have it in his power to gratify his love and sentiment, by chatting with his wife and children ashore whenever he has the mind to.

Travellers, again, in distant lands, if they wish—which, in view of the inevitable book, they probably will not—will, at least, have the means of communicating items of their journeyings to friends at home, as it will simply mean the carriage of a battery on the head of an additional porter, or on the back of an extra mule. The Polar expedition of the future, too, instead of trusting to the evident insecurity and frailty of pigeons as news bearers, will be able to speak with the interested ones of the country they belong to—and order off the usual relief expedition at the exact time, and to the exact spot necessary.

In short, as will easily be seen, this one small point gained and the country will be changed in every respect, socially, commercially, and economically; and Signor Marconi, if not the discoverer, in popular estimation certainly the applier of the new style of thing, deserves his statue of bronze if any pioneer of progress ever did, whether the statue, considering the extra pace and nervous strain involved, will remain a well washed and honoured one, is another matter altogether.

J. Rees.

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### The Electric Arc.

I have been much interested in the renewed speculations with regard to the electric arc that American research seems to have given rise to, and with others have been somewhat amused at their methods. Some of M. Blondel's latest methods seem also to merit some criticism. It is against the laws of Newton that he should be able to detect a counter E.M.F. even $\frac{1}{600}$th of a second after breaking the current (1) because no storage action has been detected in the arc, and if such action did go on it would involve a difference between the striking E.M.F. and the constant E.M.F.

(2) Supposing the counter E.M.F. to persist for a certain time after the impressed E.M.F. has been withdrawn. Let it persist (*a*) for a definite time, say, $\frac{1}{n}$th second. Then, if in the alternating arc we increase the alternations, the resistance due to counter E.M.F. diminishes till at $n \sim$ per second the counter E.M.F. is zero, which is absurd—as we used to say in Euclid.

(*b*) If the counter E.M.F. persists for a certain fraction of the time of impressed E.M.F., this would make peaky E.M.F. curves still more peaky, and would introduce a new

harmonic in the curve, suppositions contrary to fact, as the flattening of peaky curves in the arc shows.

I have, therefore, the following hypothesis to offer for the action of the arc, founded on observations and experiments carried on for some time at the electricity station here (at Prospect Hill Waterworks), and I do so before these observations have been completely concluded, in the hope that some "mightier pen" may turn his attention to this aspect of the arc. Let us take the case of the arc between carbon electrodes. Carbon is a tetravalent element at ordinary temperatures, but we know little or nothing of its behaviour at very high temperatures, for instance, that of the arc. It struck me that it was not only possible but probable, that the carbon molecule became dissociated, forming two molecules, each divalent; the tetravalent molecule may be assumed for theoretical considerations to be a compound (of two divalent molecules) which we may term carbide of carbon. This dissociation takes place at the surface of the positive carbon and is a percentage dissociation, a phenomenon not unknown in chemistry. Now, if this be the actual state of affairs the formulæ for electrolytic action should hold good, because, although the second stage of the reactions is different, the first is the same. On this assumption, the electrolyte is carbide of carbon, the ion divalent carbon, whose chemical equivalent is therefore 6. Now,

$W = C\,T\,\epsilon$

= current × time × electro-chemical equivalent.

If $C = 10$ amperes, $T$ = one second, $\epsilon = \cdot000010384 \times 6$ we have

$W = 10 \times 1 \times \cdot000010384 \times 6$

$= \cdot00062304$ gramme dissociated per second.

$\cdot00062304 \overline{)1\cdot}$

$1{,}605$ seconds to dissociate one gramme.

Now for the arc under consideration the watts were 400,

$$\therefore 1{,}605 \text{ (Secs.)} \times 400 \text{ (Watts.)} \times \cdot24 \text{ (Cals. in one watt.)} = 154{,}080 \text{ calories.}$$

Again, $10^8\,E = 10\,\epsilon\,H\,J$, where $E$ = volts, $H$ = calories, $J$ Joules equivalent,

$\therefore 10^8\,E = \cdot000010384 \times 6 \times 10 \times 154{,}080 \times 42 \times 10^6$

$= 40\cdot316171344$ volts.

This was almost exactly the volts between the terminals of the arc.

Iron was now taken for electrodes, and the same observations carried out. The chemical equivalent of divalent iron is 27·95.

The watts consumed were, on the average, 270.

Taking the two formulæ as before,

(1) $W = C\,T\,\epsilon$. $C = 10$ amperes, $T$ = one second.

$= 10 \times 1 \times \cdot000010384 \times 27\cdot95$

$= \cdot00029035$ gramme per second dissociated

$\cdot00029035 \overline{)1\cdot}$

$= 344$ seconds to dissociate one gramme.

(2) $10^8\,E = 10\,\epsilon\,H\,J$,

and 270 watts × 344 secs. × ·24 = 22,291·2 calories.

$\therefore 10^8\,E = 10 \times \cdot00029035 \times 22{,}291 \times 42 \times 10^6$.

$\therefore E = 27\cdot182805770$ volts.

This represents the calculated voltage of the iron arc. The iron is tetravalent and is dissociated, the tetravalent molecule becoming two divalent molecules. As before then we may assume an electrolyte "ferrous ferride," and the volts thus calculated are exactly those observed.

Returning to the physical aspect of the arc, it seems to me that the current on arriving at the end of the positive carbon dissociates a certain percentage of the carbon molecules, the electrical energy being absorbed *without heat* to keep up this dissociation. This accounts for the counter E.M.F. which I assume to be the energy of chemical affinity required to keep divalent carbon in that form. But the dissociated carbon molecules at once combine with others to form tetravalent carbon and the latent energy of affinity is given off as heat, and therefore light. But not all the carbon molecules re-unite *in situ*. Some are carried across by some means (akin to ionic progression it may be) and thus form a conductor between the positive and negative carbons. The resistance of this will vary with its length and area. According to observation the amount carried across seems to be almost exactly $\frac{1}{10}$th of the amount dissociated. This led to some experiments on enclosed arcs, the results of which are somewhat interesting, especially with regard to the duration of the carbons. These results together with the calculations for arcs with various electrodes, especially monovalent elements, and photos of arcs taken with special reference to the foregoing hypothesis, I hope to lay before the readers of the ELECTRICAL REVIEW, firstly, if the editors will give their kind permission, and secondly, if no "bolts from the blue" are hurled at my pet theory and bring it with a crash about my ears.

**Walter D. Jamieson.**

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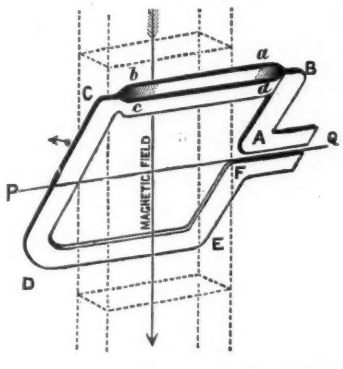
### Shielded Conductors.

Mr. Price is evidently trying to get at the truth with regard to eddy currents in buried armature conductors, and I will not deny that he may be very near it; but he made a mistake when he selected one or two of the most carefully worded statements from my letter (which appeared in your issue of January 28th), and used them as a foundation upon which to build a number of misleading and altogether erroneous deductions.

I do not wish to hurt Mr. Price's feelings, and he must not conclude that he has "again incurred my contempt," when I say that, in my own mind, I am quite convinced of his having once more "missed the point." One of the sentences quoted—the one of which I am more particularly proud—is as follows:—"Surely we are right in assuming that, *for a given E.M.F. generated*," (yes, in the main dynamo circuit if you like, or in the path of the eddies if you prefer it), "the eddy current loss in a conductor depends upon the *time* which it takes in passing into or out of the uniform magnetic field under the poles." Of course it does! The eddy current loss depends, not only upon the amount of the eddy currents, and therefore of the E.M.Fs. producing them, but also upon the *time during which these eddy currents are flowing in the metal*; and as this line becomes shorter, the heating by eddy currents will be less, not *more*, as Mr. Price would have it.

In the hope of being able to express myself in the same language as Mr. Price, I will borrow his diagram and his formula.




He says that if $N$ magnetic lines are threaded through the closed eddy current circuit, *a b c d*, in the time, *t*, the heat developed is proportional to $\frac{N^2}{t}$, which is quite true; but, in his endeavours to prove that my explanation conveys the opposite meaning to that which was intended, he has no right to consider $N$ and $t$ as independent variables. On the contrary, the whole argument is based on the assumption (printed in italics, which Mr. Price has omitted) that the E.M.F. generated $\left(\frac{N}{t}\right)$ is constant; hence $N^2 \propto t^2$, and the heat developed, is proportional to $t$.

Q. E. D.

[Perhaps I ought not to have taken it for granted that the E.M.F. tending to produce eddy currents bears a definite relation to the E.M.F. in the main dynamo circuit; but an inspection of Mr. Price's figure will show that the assumption is correct. A given conductor moves into, and through, a field of a given configuration at a certain speed. Let $E$

be the E.M.F. in the compound bar, B C, as it moves through the field, and *e* the mean E.M.F. generated in the eddy current circuit, *a b c d*, as the bar enters the field. Now double the speed of the conductor, and halve the strength of field. It is quite evident that both E and *e* remain the same as before.]

Having disposed—it is hoped, successfully—of Mr. Price's criticisms, I may, perhaps, allow myself to step down, and say a word or two on his behalf. Although he did not do me justice, that is no reason why I should not deal fairly with him, especially as I am inclined to think that his point of view is the right one.

Mr. Price does not put his case clearly; but what he says amounts to this:—

*Firstly*, he does *not* believe in the "snapping across" of the lines as the buried conductor enters or leaves the field. On the contrary, he maintains that such a conductor will, other things being equal, take the same time in passing into or out of the uniform field under the poles as a surface conductor. (It is a pity he did not mention this at the start.)

*Secondly*, the uniform field in which the conductor finds itself after passing through the "fringe," is very much weaker in the case of a buried than in that of a surface conductor. To quote Mr. Price's own words, "The solution of the difficulty lies clearly in the small intensity of the maximum field, the rate of speed at which the bars enter that field being assumed to be constant." (I have slightly altered the second half of the sentence, as it is of more interest to know what Mr. Price meant to say than what he actually said). The fact that the above statement is diametrically opposed to the views which Mr. Price expressed in his article, tends only to enhance its value by clearly proving its author to be actuated by no meaner motive than a desire to get at the truth, and nothing but the truth.

In conclusion, I would advise anyone interested in the subject to go carefully through Mr. Price's letter, skipping only the one or two irrelevant paragraphs. If he will take the time and trouble to go sufficiently deeply into it, he may disinter much valuable information, which will be of use to him in after-life.

Alfred Still.

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### Is an Electric Traction Engine Subjected to Shocks, or is it not?

I gather from Mr. Raworth's further criticism in your issue of the 4th inst., on Dr. Emery's article, that the doctor, although, no doubt, right in intention, is wrong in contention.

Experience has shown us that it is advisable to employ a higher factor of safety in designing an engine liable to frequent, sudden, and extreme variations of load, as when driving a rolling mill or electric traction dynamo, than for an engine having a constant and regular load such as electric lighting.

In answer to the question at the head of this letter, I know of a peculiar shock to which engines not designed to do the duty they are called upon to perform, are particularly liable. Dr. Emery's experience, I can imagine, causes him to dread this shock, but Mr. Raworth appears to be in happy ignorance of it. I refer to the nasty jar occasioned by precipitation on to the "scrap heap."

I am glad Mr. Raworth no longer poses as the instructor of "young engineers," and the slayer of "dead dogs," for the former are probably competent to form opinions on elementary problems, and the "dog" of American experience and practice, judging by the ominous twinkle in his eye, is far from being killed by Mr. Raworth's frequent bladder belabourings.

I see that Mr. Raworth has now assumed the *rôle* of Pharaoh, which appears to me to be far more profitable and becoming, although it is rather late to dream the dream when the "lean kine" of American enterprise are so rapidly eating up the "fat kine" of British contracts. I can only hope that Mr. Raworth and other English manufacturers will bestir themselves, and speedily acting on the interpretation of the dream will, through their respective Josephs, gather in of the rich harvest of American knowledge before the famine is upon them.

James F. Rossiter.

### Mr. Robert Hammond and Shoreditch Destructor.

I read with a huge amount of astonishment in your account of Mr. R. Hammond's opinion of the Shoreditch destructor, that several instruments or parts of our machinery have been rendered useless by reason of the dust, &c., emanating from the destructor. I can only say that no such thing has ever happened; and I certainly think Mr. Hammond should state his authority for the statement or withdraw the same as publicly as he has made it. He is entitled, of course, to his opinion as to the design or merit of the plant, but I must say his remarks do not harmonise with the voluptuous praise he bestowed upon the joint scheme and general design when he and our Gloucester friends were so courteously conducted over our works.

H. E. Kershaw,
*Chairman of Electric Lighting Committee, Shoreditch Vestry.*

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In your last issue I notice, under the heading of "Electric Lighting and Dust Destructor for Gloucester," some comments made by Mr. Hammond, which are absolutely untrue and without the slightest foundation whatever. I refer to his statement wherein he says that some of the machinery has been disabled owing to the dust, and I now wish to state that no machinery or plant whatever has been disabled at this station, through the dust or otherwise.

And, in the interests of other Corporations having destructors under consideration, also of my staff and self, I trust that you will give publicity to this letter in your next issue.

Also, I would point out that such garbled and misleading statements, as put forward by Mr. Hammond, are but a poor return for taking the trouble to show him and his Gloucester friends over these works, when full information and particulars were given him by the Chairman of my Committee (Mr. Kershaw), and

C. Newton Russell,
*Chief Electrical Engineer.*

Coronet Street, Shoreditch,
*February 8th*, 1898.

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## THE ELECTRICAL ENGINEERS VOLUNTEERS.

Certain important modifications have been made in the constitution of this corps, which, we think, will tend to popularise it among engineers. We know from our own experience that a good class of men are ready to join if it is made easy for them to fraternise on terms of equality with their fellow privates. It is obvious, from the rules that have been formulated and reproduced below, that the corps will be one of high standing; that is to say, the terms of entry guarantee the rank and file being composed of men of some position in the industry. In its present form, the corps is deserving of the heartiest support, and we trust that electrical engineers will show their sympathy by enrolling themselves as members.

The following information has been issued from head-quarters:—

The head-quarters of the corps will be at 13, Victoria Street, Westminster.

The uniform will be the same as that worn by other Royal Engineer Volunteers, with such modifications as the War Office approve. Members will pay for their own uniforms; but the corps will reimburse the cost to efficient members to the extent of one-half of the Government grant they earn by their efficiency, so that after two years' efficiency the cost of the uniform will be repaid.

The corps will be armed with the Lee-Metford rifle.

The training is divided into two kinds—military and technical.

The military work consists of infantry drills, musketry, &c.

The technical work includes every application of electricity to war, with the exception of telegraphy, and such other work as will be useful to an electrician or engine driver in carrying out his duties, such as signalling, fitting, loading, priming, and connecting up submarine mines, a certain amount of boat work, and knotting, splicing, &c.

This work will be carried out partly at head-quarters, but mainly at defended ports.

In order to become efficient each member must attend a continuous training at a defended port for at least eight days each year. In

addition, 78 hours' technical work must be done each year (48 after passing as "expert"). Each working day—after the first eight—of the continuous training counts as six hours; each full day counts six hours; each half day four hours. The remainder may be made up in periods of 1, 1½, 2, 2½, 3, and 3½ hours.

The capitation allowance is £5.

An allowance of 5s. is made for a whole day, 2s. 6d. for a half-day: but a "recruit" must attend 40, a "trained man" 20, an "expert" 10 hourly drills before earning these allowances. During the continuous training each member earns 5s. a day. The whole of these allowances will be devoted to the maintenance in camp and to the remuneration of efficient members.

Drills—both military and technical—will begin as soon as members are enrolled.

Intending members are requested to study the conditions of efficiency. Every effort will be made to make it easy to comply with them.

Below will be found an extract from the rules of the corps:—

5. Every enrolled member who is non-efficient in any year shall pay to the funds of the corps, on or before November 10th in that year, a sum equal to half the Government capitation allowance which he failed to earn. . . . . The commanding officer shall have power to remit payment, wholly or in part, in special cases.

8. No person shall be admitted as member or honorary member unless proposed by one or more members of the corps, and approved by the commanding officer.

24. Any member wishing to leave the corps may do so on November 2nd, providing he shall have given notice of his intention not later than the 30th of the preceding September. Failure to comply with this rule shall render him liable for half the amount of the succeeding year's capitation grant.

Intending members should write to the adjutant, Captain Brady, R.E., 13, Victoria Street, S.W., who will supply all information. They should give their full name, address, occupation, and electrical qualifications. If they wish to join as engine drivers they should state their qualifications for that work.

Every application must be accompanied by a reference to a member of the corps or to some other person well known to the commanding officer.

Before enrolment, each candidate must be passed as fit by a medical officer.

Every member shall be enrolled for three years at least. A member leaving before completing three trainings shall be liable to a penalty.

Hence a member who serves for three years, and is efficient in each year, will be put to practically no expense, as he will have incurred no penalties, and the cost of his uniform and camp expenses will have been refunded to him.

J. Hopkinson, F.R.S., Major,
*Commanding the Electrical Engineers, R.E. (Volunteers).*

## BUSINESS NOTICES, &c.

**Agency.**—We understand that the Edison and Swan United Electric Light Company, Limited, has appointed the Direct Importers, Limited, of Bulawayo, sole agents for Rhodesia.

**Art Metal Work.**—We understand that the business of Messrs. G. R. De Wilde & Co., carried on for the past 12 years by Mr. George Rexworthy De Wilde at 10 and 11, Archer Street, Shaftesbury Avenue, has been purchased by Messrs. Thomas Potter & Sons, and amalgamated with their own business, of ecclesiastical and art metal workers, which has been carried on since 1827 at 44, South Molton Street. Mr. De Wilde has joined Messrs. Potter & Sons, and will in future have charge of this branch of their business.

**Bankruptcy Proceedings.**—The *London Gazette* gives notice of the release, on January 12th, of the trustee (T. H. Stephens) in *re* Thomas Maddren (T. Maddren & Co.), electrician, of Cardiff.

A first and final dividend of 3s. 9d. in the £ has been notified under the failure of George Thompson (G. Thompson & Co.), electrical engineer, of Queen's Road, Brighton.

**Brussels Exhibition Awards.**—In last Friday's *London Gazette* we observe a long list of the awards made in the British Section of this Exhibition. Among the members of the Executive Committee of the British Commission, who have received awards, are the following:—*Diplomes d'Honneur* to Sir A. K. Rollit, Mr. James Dredge, C.M.G., Sir E. H. Carbutt, and *diplomes commemoratifs* to Sir F. A. Abel, Major S. Flood Page, Mr. E. Windsor Richards, Mr. Alex. Siemens. *Diplomes commemoratifs* have also been awarded to Mr. W. H. Massey, Mr. R. W. Blackwell, and Mr. Philip Dawson. Among the industrial exhibitors are the following awards: *Hors Concours* to Mr. R. W. Blackwell. *Grands Prix* to Brush Electrical Engineering Company (in participation with the Electrical Syndicate, Brussels Exhibition), Eastern Telegraph Company, Elliott Bros., Fielding and Platt (in participation with the Electrical Syndicate, Brussels Exhibition). *Diplomes d'Honneur* to Fielding and Platt, W. T. Glover, C. A. Parsons & Co., J. S. Raworth, Ruston, Proctor & Co., Tangyes, Limited. Gold medals to—Eastern Telegraph Company and Horsfall Furnace Company, Thomas Parker and Co. Silver medals to—Forced Draught Syndicate, Roller Bearings Company. Among the awards to collaborators are:—*Diplome d'Honneur* to Mr. George Elphinstone (Messrs. Elliott Bros.), and a gold medal to Mr. F. B. Behr (lightning express).

## Electrical Wares Exported.

| Week Ending Feb. 1st, 1897. | £ | s. | Week Ending Feb. 1st, 1898. | £ | s. |
|---|---|---|---|---|---|
| Adelaide ... ... | 150 | 0 | Adelaide ... ... | 37 | 0 |
| Alexandria ... ... | 29 | 0 | Amsterdam ... ... | 360 | 0 |
| Amsterdam ... ... | 55 | 0 | Bangkok. Teleg. mat. ... | 71 | 0 |
| Bombay ... ... ... | 263 | 0 | Beira ... ... ... | 1,355 | 0 |
| Buenos Ayres ... ... | 22 | 0 | Bombay ... ... ... | 13 | 0 |
| Calcutta ... ... | 333 | 0 | Boulogne ... ... | 69 | 0 |
| Cape Town ... ... | 256 | 0 | Brisbane. Teleg. poles... | 1,975 | 0 |
| „ Teleg. mat. | 221 | 0 | Buenos Ayres. Teleg. mat. | 386 | 0 |
| Colombo ... ... | 18 | 0 | Cape Town ... ... | 1,324 | 0 |
| Copenhagen. Teleg. mat. | 35 | 0 | Calcutta... ... ... | 220 | 0 |
| Demerara. Teleg. mat. | 113 | 0 | Channel Isles ... ... | 25 | 0 |
| Durban. Teleg. mat. ... | 243 | 0 | Christiana ... ... | 10 | 0 |
| East London ... ... | 3,133 | 0 | Colombo... ... ... | 199 | 0 |
| Fremantle ... ... | 12 | 0 | Constantinople ... ... | 1,060 | 0 |
| „ Teleg. mat. | 2,965 | 0 | Copenhagen ... ... | 19 | 0 |
| Gothenburg ... ... | 18 | 0 | Delagoa Bay ... ... | 83 | 0 |
| „ Teleg. mat. | 146 | 0 | Durban ... ... ... | 469 | 0 |
| Hamburg ... ... | 225 | 0 | East London ... ... | 168 | 0 |
| Launceston ... ... | 21 | 0 | Flushing ... ... | 19 | 0 |
| Melbourne ... ... | 1,400 | 0 | Fremantle ... ... | 771 | 0 |
| „ Teleg. mat. | 709 | 0 | Gibraltar ... ... | 79 | 0 |
| Ostend ... ... ... | 30 | 0 | Gothenburg ... ... | 15 | 0 |
| Port Elizabeth ... ... | 519 | 0 | Hamburg ... ... | 78 | 0 |
| Rangoon ... ... | 33 | 0 | Hong Kong ... ... | 76 | 0 |
| Reval ... ... ... | 90 | 0 | Lisbon ... ... ... | 300 | 0 |
| Saigon ... ... ... | 98 | 0 | Ostend ... ... ... | 35 | 0 |
| Shanghai ... ... | 105 | 0 | Rio Janeiro ... ... | 195 | 0 |
| Singapore ... ... | 64 | 0 | Rotterdam. Teleg. mat. | 150 | 0 |
| Stockholm. Teleg. mat. | 209 | 0 | Shanghai ... ... | 522 | 0 |
| Sydney ... ... ... | 1,002 | 0 | St. John's, N.B.... ... | 20 | 0 |
| Tientsin ... ... ... | 25 | 0 | Stockholm ... ... | 30 | 0 |
| Wellington. Teleg. mat. | 971 | 0 | „ Teleg. wire | 179 | 0 |
| Yokohama ... ... | 508 | 0 | Sydney ... ... ... | 582 | 0 |
| | | | Wellington ... ... | 105 | 0 |
| | | | „ Teleg. mat. | 292 | 0 |
| | | | Yokohama ... ... | 3,978 | 0 |
| Total | £14,021 | 0 | Total | £15,260 | 0 |

## Foreign Goods Transhipped.

| | £ | s. |
|---|---|---|
| Alexandria ... ... | 9 | 0 |

## Electrical Wares Exported.

| Week Ending Feb. 8th, 1897. | £ | s. | Week Ending Feb. 8th, 1898. | £ | s. |
|---|---|---|---|---|---|
| Aden. Teleg. cable | 10,080 | 0 | Albany ... ... ... | 55 | 0 |
| Albany ... ... ... | 221 | 0 | Alexandria. Teleg. mat. | 205 | 0 |
| Antwerp ... ... | 226 | 0 | „ Teleg. cable | 387 | 0 |
| Bangkok ... ... | 55 | 0 | Amsterdam ... ... | 107 | 0 |
| Bombay ... ... | 41 | 0 | „ Teleg. mat. | 13 | 0 |
| Calcutta... ... ... | 76 | 0 | Auckland ... ... | 44 | 0 |
| Cape Town ... ... | 89 | 0 | Bombay ... ... | 97 | 0 |
| Colombo ... ... | 198 | 0 | „ Teleph. mat. ... | 21 | 0 |
| „ Teleg. mat. ... | 61 | 0 | Boulogne ... ... | 188 | 0 |
| Demerara. Teleg. mat.... | 18 | 0 | Buenos Ayres ... ... | 824 | 0 |
| East London ... ... | 1,117 | 0 | „ Teleg. pole | 300 | 0 |
| Gibraltar. Teleg. mat. | 36 | 0 | Calcutta... ... ... | 345 | 0 |
| Gothenburg ... ... | 20 | 0 | Cape Town ... ... | 1,794 | 0 |
| Hong Kong ... ... | 110 | 0 | Charters Towers ... | 120 | 0 |
| Merosyne. Teleg. mat. .. | 27 | 0 | Colombo ... ... | 160 | 0 |
| Montevideo ... ... | 30 | 0 | Durban ... ... ... | 249 | 0 |
| Passages ... ... | 155 | 0 | „ Teleg. mat. | 17 | 0 |
| Port Elizabeth .. ... | 453 | 0 | East London ... ... | 368 | 0 |
| Rio Grande De Sul Teleg. mat. ... | 40 | 0 | Flushing ... ... | 23 | 0 |
| Syra. Teleg. mat. ... | 34 | 0 | Gibraltar ... ... | 60 | 0 |
| Rangoon. Teleg. mat. ... | 18 | 0 | Gothenburg ... ... | 148 | 0 |
| Reval ... ... ... | 120 | 0 | Hamburg ... ... | 276 | 0 |
| „ Teleg. mat. | 206 | 0 | Malaga ... ... ... | 210 | 0 |
| Shanghai ... ... | 55 | 0 | Melbourne ... ... | 610 | 0 |
| Singapore ... ... | 78 | 0 | Naples ... ... ... | 13 | 0 |
| Wellington ... ... | 206 | 0 | Port Elizabeth... ... | 119 | 0 |
| Yokohama ... ... | 31 | 0 | „ Teleg. mat. | 267 | 0 |
| | | | Rotterdam. Teleg. mat. | 110 | 0 |
| | | | Shanghai ... ... | 33 | 0 |
| | | | Stockholm ... ... | 1,850 | 0 |
| | | | Sydney ... ... ... | 370 | 0 |
| | | | Trinidad ... ... | 27 | 0 |
| | | | Wellington ... ... | 26 | 0 |
| Total ... | £13,801 | 0 | Total ... | £9,436 | 0 |

**Calendars.**—From the Peckham Truck Company (Mr. R. W. Blackwell, 39, Victoria Street, S.W.) we have received a calendar for the year, 1898. It is made up of very large sheets—one for each month, on each of which there appears a good photographic view of electric and cable cars, trucks, &c., supplied by this well-known company.

Messrs. King & Co., electrical engineers and contractors, Leith, also send a neat calendar.

A handy-sized and serviceable wall calendar has been brought out by Messrs. Nalder Bros. & Thompson.

**Catalogues.**—Mr. Harry W. Cox, of Cursitor Street, has issued a pamphlet describing and pricing various apparatus supplied by him for use in Röntgen ray research, such as induction coils, focus and vacuum tubes, screens, batteries, &c.

The Electrical Sundries' Company, of Berners Street, have issued a new and enlarged catalogue of their electrical fittings and accessories. Cut-outs, switches, fuses, wall plugs, lampholders, standards, counterweight and other hanging fittings, brackets, pendants, hall lanterns, electroliers, lamps, &c., are among the variety of electric light apparatus and fittings.

**Copper.**—Messrs. H. R. Merton & Co. have prepared tables showing the stocks of copper in England and France, and advised from Chili and Australia. Their statement is as follows:—

| | Tons. | £ | s. | d. |
|---|---|---|---|---|
| Jan. 31st, 1895 .. .. .. .. .. | 54,848 at | 40 | 5 | 0 |
| „ 1896 .. .. .. .. .. | 46,128 „ | 43 | 17 | 6 |
| „ 1897 .. .. .. .. .. | 32,307 „ | 51 | 2 | 6 |
| Dec. 31st, „ .. .. .. .. .. | 31,955 „ | 48 | 5 | 6 |
| Jan. 15th, 1898 .. .. .. .. .. | 38,033 „ | 48 | 15 | 0 |
| „ 31st, „ .. .. .. .. .. | 29,746 „ | 49 | 0 | 0 |

The following figures show the total supplies and deliveries:

| | Supplies Tons. | Deliveries Tons. |
|---|---|---|
| Feb. 28th, 1895, to Jan. 31st, 1896 .. .. | 142,928 | 152,648 |
| „ 29th, 1896, to „ 1897 .. .. | 206,224 | 220,045 |
| „ 28th, 1897, to „ 1898 .. .. | 221,195 | 223,756 |

**Croydon Tramways Company v. The British Electrical Traction Company.**—In the Appeal Court on Tuesday, the Master of the Rolls, Lord Justice Rigby, and Lord Justice Vaughan Williams, heard an appeal by the Croydon Tramways Company against a judgment of Mr. Justice Kekewich in the Chancery Division. This judgment was briefly referred to in the Electrical Review for January 21st, page 79. In January, Major-General Kaye sued in the Lower Court, on behalf of himself and other ordinary shareholders in the Croydon Tramways Company, asking that the company might be restrained from carrying out an agreement for the sale by them of the undertaking and its lines to the British Electric Traction Company. After hearing counsel's arguments, Mr. Justice Kekewich granted an interim injunction restraining the directors from carrying out the agreement to sell their undertaking to the British Electric Traction Company. Mr. Cripps, Q.C., Mr. Warrington, Q.C., and Mr. Rowden appeared for the appellants; Mr. Bramwell Davis, Q.C., and Mr. Bradford for the respondents. The case was opened on behalf of the appellants, and Mr. Bramwell Davis and Mr. Bradford replied for the respondents, after which the hearing was adjourned.

When the case was resumed yesterday, the Master of the Rolls said their lordships had come to the conclusion that it would be extremely difficult to do justice in the matter in the absence of the British Electric Traction Company. He therefore thought that the appeal had better stand over in order to allow of the purchasing company being added to the motion. The case was adjourned for a fortnight.

**"Isolacit."**—This is the name of an insulating and acid proof material made by Messrs. Baeumcher & Co., of Dresden, who have just appointed Mr. Archibald Campbell, of 28, Gray's Inn Road, W.C, sole agent in England. It is stated to have given great satisfaction to a number of the best-known electrical manufacturers and electric railway companies, also in battery establishments, in Germany. It is produced in different mixtures, liquid, semi-liquid, and solid, and among the advantages claimed for it are the following:—It does not burn, ignite, or entirely lose its elasticity, but adheres to the movements of ductile and pliable objects without becoming brittle or cracked. It is not troublesome to use, and there are no unhealthy evaporations. It is not affected by the most acrid acids.

**Lists.**—Mr. C. R. Heap, 47, Victoria Street, S.W., the sole importer for the United Kingdom for the C. and C. Electric Company, of New York, sends us lists of that company's bipolar dynamos and motors. The list gives some very neat blocks of the straight and curved field types, and detailed particulars of same. The C. and C. slow speed generator is also described.

**Lloyd & Lloyd v. D. & W. Henderson & Co.**—Sheriff Strachan, on 31st ult., heard proof in an action at the instance of Lloyd & Lloyd, of Birmingham, holders of letters patent in the United Kingdom for the Benardos system of electric welding, against D. & W. Henderson & Co., engineers and shipbuilders. The pursuers sought to bind the defenders to an agreement which they entered into in 1892 to pay a royalty of £200 per annum for the use of the inventions comprised in the pursuers' patent. After paying royalty for two years, the defenders, it is alleged, refused to further implement the agreement, assigning as a reason, among others, that the invention could not perform the operations which it was alleged to be able to perform. Pursuers denied the defenders' allegations, and contended that the defenders, by letter, agreed to hold themselves bound by the deed and signature of Mr. Andrew Henderson. When the hearing was resumed, Mr. Bannatyne, addressing the Court for the defendants, said the first and most important question was whether or not there was a completed agreement between the parties, and the second point was, assuming there was a completed agreement, could the document be set aside on the ground of fraud and essential error. He did not mean deliberate fraud, but innocent and unintentional concealment of material alterations, amounting to fraud in a civil action. The precedents showed that, in order to have perfect obligation, there must be deliberate and voluntary consent. Defendants' case was that they were induced to sign the license sued on through concealment on the part of plaintiffs. The duration of the license was a matter of importance to defendants. They bought the plant for experimental purposes, and never contemplated the further burden of an annual payment of £200 to the end of the patents. The draft they approved of did not contemplate that, and it was amended to place the question of duration beyond doubt, if possible. If there was doubt about the meaning of the clause, apart from amendments, it must be read against plaintiffs. The Court would have to find there was no consent given by defendants to this contract. It was a Scotch contract, and must be construed by the law of Scotland. Accordingly, it should have been signed on each page by both parties before witnesses, and by all the partners of the firms. It was not a mercantile document, but it was a formal deed, and not being executed according to the formalities of signing in Scotland, the license could not be enforced in Scotland. Judgment was reserved.

**Personal.**—Mr. T. Scott Anderson, of Sheffield, asks us to state that his practice as a consulting engineer is being carried on as before, and is not a branch of the new firm of Scott Anderson and Beit. We understand that he has just received instructions from the District Council of Kilnhurst to survey and report upon the lighting of their district. He is further retained by the directors of new steel works in Yorkshire to report upon the complete equipment in their works of lighting, welding, and motor plants.

**Private Bills.**—The Examiners of Private Bills sat at the House of Commons on Monday to consider the standing order proofs of Bills lodged for consideration during the present session. There was "no appearance" registered in the case of the Folkestone Electric Tramways Bill. In the case of the Hastings and St. Leonards Tramways Bill, which had been part heard by the examiners, the petition was endorsed "no appearance on adjournment." The consideration of the Bill was further adjourned until the 21st inst. The consideration of the London United Tramways Bill and the Blackpool and Fleetwood Tramroad (Tramways Extensions) Bill was postponed.

**South African Electrical News.**—The *British and South African Export Gazette* has the following items:—A scheme having been mooted for lighting Kokstad, Cape Colony, with the electric light, opportunity will shortly be afforded for electric engineering firms to tender for the requisite material. Overhead wire to the extent of 47,300 feet, for the purpose of lighting Bulawayo, has been supplied to the order of the Bulawayo Waterworks and Electric Light Company. The installation of the electric light in the railway workshops at Mafeking is under the consideration of the Railway Department, and the extension of the system to the town is also mooted. In this event very considerable orders for machinery and material will shortly be placed. The two large alternating current dynamos, of 15,000 lamps capacity each, with 1,250 revolutions per minute and a voltage of 2,288, required for the electric lighting of Bulawayo, have been supplied to the Bulawayo Waterworks and Electric Light Company by the General Electric Company of New York. The completion of the equipment of the Village Main Reef gold mine only awaits the arrival of the electric plant, for some time on order, but delayed owing to the engineering strike. An order for a small dynamo, to supplement the existing electric lighting plant, has been placed by the Durban Municipality. Two automatic cut-off engines of 150 H.P. each have been supplied by Messrs. McIntosh, Seymour & Co. for the Bulawayo Waterworks and Electric Light Company.

**Sunderland Exhibition.**—At this Exhibition the Sunderland Forge and Engineering Company, who carried out the electric lighting of the buildings, putting in 50 arc lamps and about 30 100-C.P. and 250 16-C.P. incandescents, exhibit at their stand two inverted vertical compound double-acting enclosed self-lubricating central valve engines coupled direct to two compound-wound dynamos of the inverted two-pole pattern. They also show several ship lighting plants, and a 25-B.H.P. enclosed motor driving a joggling machine.

## ELECTRIC LIGHTING NOTES.

**Aberystwyth.**—It is proposed, in view of having a fresh agreement with the Electric Lighting Company, to obtain their terms for the extension of the arc lighting and also for three years' incandescent lighting.

**Beckenham.**—The District Council has agreed to supply electricity to the district at an estimated cost of £36,000.

**Bedford.**—A correspondent says that the annual balance-sheet of the Bedford Liberal Club shows that by adopting the electric light a saving of £40 has been effected, for whereas electricity costs £41, with a gas bill of £5, the gas bill alone formerly amounted to a sum of £90.

**Belfast.**—The Electric Committee says that it cannot supply current for the Exhibition Hall, Botanic Gardens Park (as required for the year) until the new supply station is in working order. But as the parties will rest content for the present with 50 8-C.Ps., the supply is to be furnished and a main laid. The storage battery and switchboard contractors are ready to begin delivery. The central station is already partly insured in the Fine Art and General, and other companies are being negotiated with. The electrical engineer is to wait on Messrs. Harland & Wolff in reference to their application, and ascertain "what voltage they would require the electric current to be supplied at, and also to inform them that the Committee would be prepared to supply up to 1,000 Board of Trade units per annum on a maximum demand of not more than 500 H.P. at 2½d. per unit, and beyond that on the same maximum demand at 1½d. per unit, the cable to be laid to their gate."

The Board of Guardians are asking Mr. Clegg to submit an estimate of the cost of electric lighting plant, and the maintenance thereof, for the Workhouse.

**Bromley.**—The Bromley Urban District Council are still holding over the transfer of the Electric Lighting Order, having, in response to their inquiries, received what they consider to be a most unsatisfactory reply from the company.

**Burnley.**—The Council has accepted a tender (£4,888) for the supply of two combined engines coupled with dynamos for extending the electric lighting works.

**Cardiff.**—The electrical engineer has reported to the Lighting Committee upon the mains generally throughout the town. He suggests that the cables supplying the arc lights be replaced by others, and that the lamps be connected to them in accordance with the latest Board of Trade requirements. If this were not done, he would not be surprised at a failure of some of the lamps after any heavy wet weather.

**Devonport.**—The Council has appointed Prof. Kennedy to prepare an electric lighting scheme for the district.

**Dorking.**—The District Council has, after discussion, resolved to introduce the electric light into Dorking, and an Electric Lighting Committee has been appointed to report.

**Dover.**—Some of the consumers have been conferring with the Electricity Supply Company *re* the charges for current.

**Dublin.**—The Local Government Board having considered Mr. Cotton's report, have notified the Corporation that the £20,000 asked for will be "loaned" subject to approval of the specification and detailed estimates in connection with the new cables and works. The Corporation will therefore have financial resources so far to carry out their new scheme for an extension of the electric lighting of the streets.

**Dudley.**—The contract for lighting by electricity the Public Hall, for the purpose of the Industrial Exhibition, was carried out by Messrs. Webster, Michelson & Co., of Dudley. There were 4 2,000-C.P. arcs and incandescents equivalent to 500 16's. The plant employed for the purpose comprised a combined high speed vertical engine and multipolar dynamo. The same firm have a stand at the exhibition where they show various electrical fittings and several "C" type Dudley dynamos and motors.

**Dundee.**—Four electric lamps are to be erected in High Street, Lochee, the electric plant at the public baths supplying the current.

**Durham.**—At the last City Council meeting a letter was read from Edmundson's Electricity Corporation, Limited, stating that proposals had been made to them by the Dean and Chapter of Durham for putting down plant for supplying the Cathedral and College with electric light. They proposed to leave a margin for the use of private consumers, and asked the consent of the Council to mains being laid through the streets to enable them to supply intending customers. The consent asked for was granted.

**Ealing.**—A report is to be prepared on the subject of the proposed application of incandescent lamps to the arc lamp posts. A mechanic is to be engaged to remedy, as far as possible, the defects in the present arc lamps.

**Edinburgh.**—A committee of the Scottish Conservative Club report that they have entered into a contract for the re-wiring and extension of the electric light installation of the Club, as well as for the supply of electric light fittings at a total cost of £1,400. The re-wiring and fitting of the smoking and reading rooms has been completed, and the remainder of the work is to be carried out during the current year.

At the meeting of the Electric Light Committee on the 1st inst. it was reported that over 2,200 8-C.P. lamps had been applied for during the last two weeks.

**Fire Station Lighting.**—The L.C.C. Fire Brigade Committee has been going into the question of electric lighting for the chief fire station, with the chief officer. He suggests that the National Electric Free Wiring Company's system of wiring should be adopted, and he proposes that, instead of the necessary plant being obtained from various firms, a contract should be entered into with the company for the supply and fixing of the plant and fittings, but that some of the fixing and the making of brackets, &c., should be executed by the workshops' staff, the company reimbursing the Council the wages of the men thus employed. The company has submitted a tender amounting to £992, such sum to include the provision and fixing of an engine and dynamo, with switchboard, cables, mains, distribution boards, branch wires, switches, incandescent lamps, batteries, &c., and 14 arc lamps. The company undertakes to employ the Council's men to assist in every possible way. The Committee recommend the Council to accept the tender of the National Electric Free Wiring Company, Limited, to carry out the electric light installation at the chief station of the fire brigade for £992, less the amount of the wages of the Council's employés who will be engaged on part of the work.

**Glasgow.**—A member of the Corporation is to move that in view of the unsteady character of the electric light in St. Andrew's Hall, of the noises emitted by the arc lamps used, and of the fact that the roof is practically invisible under the present method of lighting, a system be adopted which will be both efficient and silent.

**Greenock.**—There is a suggestion that before anything further is done in connection with the electric lighting scheme, a plebiscite of the residents be taken. The Council require to notify the Board of Trade shortly whether or not they intend to apply for a provisional order, and Mr. Tighe, electrical engineer, Paisley, has been appointed to consult with the sub-committee.

**Grimsby.**—The Public Lighting Committee has been considering the report of the sub-committee on electric lighting. The following places were visited for the obtaining of information:—South Shields, Newcastle, Leeds, Manchester, Brighton, Shoreditch, and Westminster. The sub-committee recommended the engagement of Prof. Kennedy as consulting engineer. The sub-committee added that overtures had been made by the Tramway Company as to the supplying of energy for tramway traction, and authority was asked to negotiate with the company, and obtain a definite proposal from them. It is proposed to ask Prof. Kennedy to prepare an estimate.

**Hampstead.**—The Vestry has decided to apply for a loan of £40,000 from the London County Council in order to pay for some very extensive plant for electric lighting it has just added to the central station in Finchley Road. It is hoped to finish in about six weeks' time the installation of the public electric lighting from Heath Street to Chalk Farm, about a mile and a half in length.

**Islington.**—The Electric Lighting Committee's report just issued, of the working of the electric lighting system in Islington during the year 1897, shows that whereas in the previous year a profit on revenue account had been shown of £1,615, in 1897 the profit made was £4,432. With the repayments on capital account, the loss on the two years was reduced from £1,836 to £318 14s. 4d., and this loss might have been turned into a profit but for some delay in starting the new plant. Mr. Gay, the electrical engineer, in a note to the account, says the number of units sold in 1896 was 298,000, and this produced a revenue of £7,573. In 1897 there were 504,000 units sold, or an increase of 206,000, being equivalent to 69 per cent. In 1896, the working cost was £5,958, equivalent to nearly 4¾d. per unit. In 1897, it was £7,858, an increase of £1,900, and equal to 31 per cent.; the cost per unit falling to 3¾d., or a penny per unit less than the previous year. Thus, with an increased cost of production of 31 per cent., the out-put has increased 69 per cent., and the revenue 62 per cent. The gross profit in 1896 only amounted to 21 per cent. on the revenue, but last year it rose to 36 per cent., a very satisfactory increase. The capital account now stands at £150,850, of which £6,623 remains in hand.

The increasing demand for current here has necessitated further extensions, and £12,000 has been voted by the Vestry for purchasing and erecting the new plant, which will include two boilers, a 1,500 H.P. engine, and 1,300 kw. alternator, at a cost of £7,180. The steam and other pipes and fittings, also foundations, accumulators, boosters, and various accessories, will amount to £4,820. The Electric Lighting Committee has reported to the Vestry on the steps being taken by other local bodies regarding the payment of the trade union rate of wages.

**Lambeth.**—The Lighting Committee has reminded the vestry that the South London Electric Supply Corporation undertook to supply energy, free of charge, for 25 arc lamps, to be erected by the vestry in certain streets. The committee submitted a list of positions.

**Lancaster.**—The Electricity Committee has accepted the tender of Mr. Wm. Massey for oil, and the Scottish Asbestos Company for packing.

The Electricity Committee has increased the salary of Mr. C. E. M. Johnstone, electrical engineer, from £120 to £140 per annum.

**Leeds.**—At the present time part of Wellington Street, Boar Lane, and Briggate are illuminated at night by means of gas and electricity. It is intended shortly, however, to dispense with gas until midnight. At that hour the gas lamps will be lighted, and electricity switched off.

**Leith.**—The Special Committee on Electric Lighting has accepted the following tenders for the electric light station buildings:—Mason work, Kinnear, Moodie & Co., £7,693; joiner work, Kinnear, Moodie & Co., £934; plumber work, Patrick Knox & Sons, £269; iron work, A. Mather & Son, £1,972; glazier work, Robert Graham, £307; slater work, M'Lean & Reid, £99; plaster work, Stuart's Granolithic Stone Company, Limited, £69.

**Leyton.**—The Guardians having asked for terms for a supply of current for lighting all the workhouse buildings for two years, the Council has resolved to charge 3½d. per unit. A deputation from the Council is to go to Brighton to see how they charge for current there.

The resident engineer has reported as follows:—Electricity generated during December, 25,062 amperes; units sold, 15,981 amperes; number of applications during December, 8; total applications to date, 100; largest number of lights on at any one moment, 3,734, being 71 per cent. of the total connected.

**Liverpool.**—The electrical engineer has been empowered to proceed with a portion of the extension of the mains provided for by the estimates for the current year. The estimated cost of this work is £16,947.

**London.**—At last week's meeting of the Vestry of St. George, Hanover Square, a proposal was brought forward that an additional sum of £1,000 be granted on the lighting contracts in order that electric lighting might be introduced into the parish and the experiment made in Piccadilly. It was stated that the parish of St. George is behind all other metropolitan parishes in this matter. After discussion the motion was lost.

**Loughborough.** — A London company's proposal for obtaining a provisional order for electrically lighting the borough has been referred to the General Purposes Committee.

**Merthyr.**—Mr. Dan Thomas has given notice of motion to consider the expediency of including a sum in the next estimates, with a view to the engagement of an expert to report upon the electric lighting of the district, and probably on a scheme of electric tramways.

**Newcastle.**—A meeting of the Special Committee appointed over two years ago for the purpose of considering the provision of the electric light for the city was held last week. There was a discussion on the electric lighting of the city, and it was decided to ask the city engineer to report as to the number of arc lamps that would be required to illuminate the principal streets, and as to the power that would be required. It was felt, however, that it would be necessary to await the action of the new Tramways Committee before proceeding further, as should the committee decide in favour of electric trams, the same power might be used to supply the electric light. The city engineer is to furnish a report as to the amount of power to be produced from the waste energy of the Byker refuse destructor.

**Newington.**—Some members of the Vestry seem to fear that the London Electric Supply Corporation is cutting the ground from under its feet, by inducing the public to take current from it at 5d. per unit—a lower rate than the Vestry will itself be able to supply at when the municipal installation is put down.

**Russia.**—The annual report of the St. Petersburg and Moscow Electric Lighting Company for the year 1896-7 states, according to the *Shareholder*, that the total gross takings were £168,100, divided pretty equally between the two towns of St. Petersburg and Moscow, and the expenses were £101,000. The net receipts amounted to £59,160, and after deducting £5,060 for cost of administration for both towns there is a profit remaining of £54,100, of which £10,820 is written off for depreciation, £2,160 for Government taxes, and £4,640 for the reserve and insurance fund, leaving a net profit of £36,480, to which was added the sum of £11,300 carried over from the previous year, giving a total available for distribution of £47,780. A dividend at the rate of 6 per cent. was declared. The length of the streets in which cables have been laid is 33 miles, and next spring it is contemplated to put in 13 miles more, as the applications for connections are very numerous.

**Salford.**—At the last Council meeting, Councillor Wheatcroft asked how long it was intended to leave the electric lighting arrangements of the streets in their present condition with the wires exposed. He thought it was probable that there would be a serious leakage in consequence of this state of affairs. Councillor Hamblett, replying to the question, said that at the next meeting of the sub-committee, which had charge of the experiments, it would be suggested that the temporary arrangements referred to should be discontinued. It was a fact that there had been a considerable leakage and waste of electrical power.

**Sheffield.**—The City Council on Wednesday decided to purchase the Sheffield Electric Light and Power Company's undertaking. Pending the completion of the purchase shareholders are to receive 10 per cent. dividend.

**Shoreditch.**—In addition to the statement made by Mr. Kershaw at last week's Vestry meeting, we take from a local paper the following further remarks reported to have been made by him in answer to the objections raised by several members to too hasty a reduction in the charge per unit. Major Wenborn had stated that it would be very unwise of the Vestry to pass the report until they were placed in the possession of the information given in Committee. Mr. Kershaw said "this undertaking must be run in a commercial spirit. Their loss on the first quarter was £500, but in the second quarter they recouped that loss and got £300 to the good. One of the contractors had not yet fulfilled his guarantee, and if the figures given to the committee got into print it might be the worst day's work the Vestry ever did." This is a strong statement from the chairman of an electric lighting committee, and readers may be pardoned for wondering what figures it is so imperative to keep secret.

**Shoreham.**—The Southern Cross Shipyard and Engineering Company have offered to submit estimates and specifications to the District Council for electric lighting.

**St. Marylebone.**—For the electric lighting requirements at the new central administrative block at Marylebone Road Workhouse, 18 tenders were received, ranging from £870 to £1,765. It was proposed to accept the lowest (Messrs. H. F. Joel & Co.), but a member moved that the tender of the Marylebone firm be accepted at £927 odd. The matter was in the end referred to a Committee to make inquiries.

**Stockton.**—At last week's Town Council meeting the electric lighting question was under consideration. Mr. W. Ford, gas manager, had gone into the matter of site. He had selected three sites as being adapted for the purpose. So far, reasonable provision had been made, not only for covering the compulsory area, but for an area of something like five miles radius from the site selected. His design of the proposed buildings for engines, dynamos, and boilers had been approved by the expert. Mr. S. C. Vesey Brown reported that he had considered the three sites. He had estimated on a plant capable of supplying a total of 3,000 lamps alight, each lamp taking 30 watts. This meant that about 4,200 lamps of a similar size could be wired. The system was to be the continuous three-wire system with a pressure of 230 volts between either outer wires and the neutral wire. The cost of erecting and supplying an electricity works with boiler, economisers, engines, dynamos, pumps, pipes, crane, switchboard, storage battery, cables, meters, buildings, and chimney was:—Site No. 1, £15,145; No. 2, £15,652; No. 3, £14,297. It was resolved that a special meeting of the Gas Committee be held to consider the following resolutions:—"That the report be approved, the question of site being left for the consideration of the Council," and "That the Council be recommended to empower the committee to invite not exceeding six electric lighting engineering firms to submit sketch plans, specifications, and estimate of the cost of an installation to meet the suggestions contained in Mr. Ford's report."

**Swansea.**—It is probable we have heard the last of the triple scheme, which was the cause of so much local wrangling. The Lighting Committee has been going into the matter again, and as the Tramway Company seems determined to make their own arrangements for supplying the current for their system, the Committee has approved of a scheme for the electric lighting of the town independently. The provision of a day load for the plant was the chief matter of solicitude, but, from the promises received and the possibilities of certain works and industries taking power from the Corporation works, it is hoped by the committee that the scheme can be most profitably carried through.

**Wallasey.**—The chairman of the Gas Committee stated some days ago that their electrical installation, though only established about a year, had made a substantial surplus.

**Winchester.**—Mr. Murray, electrical engineer, Worcester, was to visit Winchester one day this week to inspect the plans and advise the committee.

**York.**—The question of dust destructors has been raised here in connection with electric lighting. A sub-committee is to report on the form of destructors.

## ELECTRIC TRACTION AND MOTIVE POWER NOTES.

**Airdrie and Coatbridge.**—The directors of the British Electric Traction Company will probably concede certain points objected to by the Corporation Committee, so as to avoid opposition to the scheme when it comes before the Light Railways Commissioners in a few weeks.

**Blackpool.**—The electrical engineer, and such members of the Tramway Committee as please are to visit Hanover, Dresden, Berlin, and Paris, for the purpose of inspecting the electric tramway systems in those towns.

**Bournemouth.**—The promoters of the light electric railway schemes, which are opposed by some of the local authorities, are still pegging away, though, we are afraid, with little prospect of success.

**Bristol.**—The Sanitary Committee has reported to the Corporation at considerable length upon the Bristol Tramways (Extensions) Bill, and the Bristol Tramways (Electrical Power, &c.) Bill, being promoted by the Tramways Company. The Committee recommend the Council to resolve—(1) "That until the question as to the right of the Corporation to regulate the mode of traction to be used throughout the city on existing and future tramways, raised by the company by the promotion of the Electrical Power Bill, has been settled by Parliament, the consent of the Corporation be not given to the Extension Bill." (2) "That the Electrical Power Bill be opposed by the Corporation, and that the conduct of the opposition be entrusted to your Committee."

The Tramways Company met the sub-committee of the Sanitary Committee on 4th inst., for a conference on these matters, but nothing particular was done.

**Clontarf.**—A deputation has laid before the Corporation their views in favour of doubling the line of trams between Talbot Street and Nelson's Pillar. The Tramway Company considers the proposal tends to facilitate the traffic to Clontarf.

**Dover.**—For the week ended Saturday, 29th ult., the receipts were £103 odd, averaging £17 4s. per day, the number of passengers carried being 24,811 for the week. The total receipts since the opening have been £2,368 odd.

**Dublin.**—The directors of the Dublin and Lucan Steam Tramway Company report to the shareholders that they are still negotiating for the electrical equipment of the line.

**Edinburgh.**—A sub-committee has resolved that, as arrangements had already been made for the cabling of the line as far as Meadowbank, the Portobello section just acquired by the Corporation should be cabled likewise. At one time, it is said, there was some talk of the Portobello section of the system being worked by electrical traction.

**Folkestone.**—It is stated that though the Corporation have decided not to approve of either of the two schemes before them for the construction of electric tramways in the borough at the present stage, they do not intend to offer any active opposition.

**Gateshead.**—The Parliamentary Committee has had an interview with the Gateshead and District Tramways Company with reference to the suggested substitution of electric traction in place of steam on the tramways.

**Great Orme.**—There was a conference between the Council's representatives and the promoters of this tramway scheme at Llandudno last week, and it is understood that the promoters agreed to take the supply of electrical energy from the Council. The Council offered terms of purchase at the end of 28 years, on a basis of 4 per cent. dividend, but the promoters declined, and a 5 per cent. basis is probable.

**Hastings.**—Last week the Council had a lengthy discussion regarding the light railway and electric tramway schemes which had been proposed for the district by private companies. The Roads Committee submitted their report dealing with the proposals, stating the result of their negotiations with the promoters, and made the following recommendations:—1. That the scheme for a suggested system of tramways submitted by Mr. T. W. Barber, C.E., be not entertained. 2. That consent be not given to the Hastings and St. Leonards Tramways scheme. 3. That the Hastings and St. Leonards Light Railways scheme, of which the British Electric Traction Company, Limited, are the promoters—under which it is propored to construct a line from a point near the west end of George Street *viâ* Castle Street and Robertson Street, to a point near the Bo-peep Hotel, and a line from the Albert Memorial *viâ* Bohemia Road to Hollington—be not assented to. 4. That consent be given to the carrying out of the Hastings, Bexhill, and District Light Railways (Electric) scheme, with certain stipulations; and that it be referred to the committee to negotiate with the promoters as to the terms and details, and report. These recommendations were not all approved by the Council. An amendment was carried receiving and adopting the report, excepting that part referring to the light railway scheme; no part of the front line is to be used for experiment with trams; all inland lines to be laid by the Corporation; the Town Clerk to oppose all schemes. The matter was referred to the Council in committee, the voting on the amendment being 26 in favour and five against.

**Kirkcaldy.**—The Provost and magistrates of Dysart have cordially taken up this electric lighting and tramway scheme, and appointed a committee to confer with the Kirkcaldy committee.

**Leeds.**—The Tramways Committee has decided to recommend the Council to extend the tramways from Wall End, Armley, to the city boundary at Stanningley. The Committee has also had under consideration the question of the equipment of the Headingley, Chapeltown, and Hunslet sections with electricity, on a similar principle to that employed on the Roundhay and Kirkstall sections, but the matter was postponed for a month.

**Light Electric Railway.**—The Earl of Jersey, Colonel Boughey, and Mr. Gerald Fitzgerald, Commissioners under the Light Railways Act, held an inquiry in the Middleton Town Hall on Saturday last to obtain information with regard to an application made by the British Electric Traction Company, Limited, for an order authorising the construction of a light railway in the district. Mr. S. Morse, of London, appeared for the company. The Lancashire County Council, the Middleton, Oldham, Rochdale, Heywood, Chadderton, and Castleton authorities, the Lancashire and Yorkshire Railway Company, and the Rochdale Canal Company were represented. They did not oppose the grant of the order, but sought to secure their interests under the order. From the statement of Mr. Morse it appeared that the Electric Traction Company propose to construct a tramway a little over 8 miles long, at an estimated cost of about £52,000, to run from Rhodes to Middleton, and to branch from thence in two directions, one running through Chadderton to Oldham, the other proceeding towards Rochdale by Castleton. The tramway is to be laid along the main road, on the electric overhead wire system. Evidence was given with regard to the great lack of means of communication by road between the places named, and it was stated that as the rails for the proposed system would be laid to the ordinary gauge of 4 feet 8½ inches, they could, as regarded the Oldham tramway system, be eventually coupled up or connected. The Oldham authority—the Town Council—opposed the grant to the company of power to construct a piece of the line, about 300 yards long, which would lie within the borough boundary. Oldham, it was said, might, when the present leases expire, decide to carry on its own tramway system. It was stated that there will be no engineering difficulties in laying the proposed line, and that no widenings of the road will be required. Asked as to the possibility of extending the line westwards from Rhodes to the Manchester tramway system at Cheetham Hill, Mr. S. Sellon, the engineer to the company, said that at the time the application was drawn it was understood that the Manchester Corporation were opposed to the overhead system. He understood it was now different, and if Manchester agreed there should be no difficulty in bringing the two systems together. The proposed tramway will run through a very populous district, which absolutely needed road connection. The Commissioners afterwards went through the clauses of the proposed order.

**Liverpool.**—The Tramways Committee are understood, says the *Liverpool Post*, to be working hard to have the experimental line of electric trams from St. George's Church to the Dingle ready and in working order by May 1st. The new machinery necessary to supply the motor power has already been laid down at the Paradise Street generating station, and the armatures rewound to give the more powerful 500-volt current necessary for the service. The wires have been manufactured and delivered, and the rails have already been shipped to Liverpool. Trolley poles have been specially designed for the Corporation, and one is now being cast from working drawings by Dr. Hopkinson. Several of the cars to be used on the line have already been delivered. Their design is novel. They are entered from the sides. The front part of the car is enclosed, and comfortably fitted up with seats divided one from another by arms as in first-class railway carriages. The ventilating arrangements are of the latest type, and the lighting throughout will be by electricity. The rear half of the car will be open, and will take the place of the present "outside." The seats are arranged cross-wise. Each car has been constructed to carry 36 passengers. As the speed will be too great to admit of passengers jumping on and off while the car is moving, it has been decided to have a stopping station at the corner of each important cross-street along the line of route. The rate of speed, with stoppages, will be eight miles an hour.

**Madrid.**—The directors of the Tramways Union Company, in their report for 1897, say that the formal sanction of the Madrid Municipality having been obtained for electrical traction, the work of transformation is now in active progress, and the directors hope the line will be in full working order early in the coming summer.

**Manchester.**—The Stretford District Council will oppose the Manchester Carriage and Tramways Bill, 1898, for using mechanical power on their lines, &c.

**Norwich.**—At the Norwich Police Court, on 3rd inst., an application was made on behalf of the Norwich Electrical Tramways Company, Limited, under the Land Clauses and Consolidation Act, for a certificate that the capital of the company had been subscribed, which was necessary before they could acquire any lands. Documentary evidence was handed in. It was shown that all the capital of the company (£240,000) had been subscribed, and 50 per cent. paid up. The magistrates, after consultation, said they had come to the conclusion that the evidence in its present state was insufficient to grant a certificate. The list of members produced was not verified in any way. The application was accordingly adjourned. The matter came before the Court again on 5th inst., and the necessary certificate was granted, an affidavit being produced from the secretary of the company stating that the book produced was the registered membership roll of the company.

**Sheffield.**—The construction of the track for the electric tramways is being pushed forward, according to the *Sheffield Independent*. Work was commenced on January 3rd. The road from Tinsley to the Wicker is practically level all the way. From Lady's Bridge, up Waingate, and then along the Fruit Market and up High Street, a heavy gradient is encountered, and the line runs through the busiest commercial part of the city, while, after leaving the Moor, the efficiency of the traction will be tried in Cemetery Road, by one of the steepest gradients to be found in Sheffield. If the electric overhead system proves equal to all the demands made upon it in the six miles from Tinsley to Nether Edge, it is likely to be successful in any other part of the city in which it is to be employed. The rails are supplied by the Barrow Steel Company; the steel points, crossings, &c., by Askham Bros. & Wilson, and Mr. R. W. Blackwell is supplying the well-known Chicago bond. The rails are laid on a solid bed of concrete. The city surveyor (Mr. C. F. Wike) is superintending the laying of the track. It is proposed to use 25 double-decked cars, each taking 51 passengers. The centre trolley poles, which will be fitted with lamp carriers, are being supplied by Messrs. Macfarlane & Co., of Glasgow, and a large number of the side standards will be made by Mr. J. Spencer, of Newbury. As already stated, the British Thomson-Houston Company will furnish the electrical equipment.

**Electric Power Distribution.**—At last week's meeting of the Dudley Town Council, a discussion took place with reference to the Electric Power Distribution Company and its proposals. The Mayor stated that he and Councillor Hooper attended the meeting at Birmingham in connection with the application of the Electric Power Distribution Company. That company was only in course of formation, and it was a mistake to say that they had offered power at 1d. per unit. It might be 1d. and it might be 3d. No offer had yet been made likely to induce that corporation to surrender their electrical powers. When they were ready with any such offer or guarantee that council would be ready to welcome them. He proposed the extension of the executive powers of the Electric Committee for two months, and this was carried.

**Electric Power Distribution.**—The representatives of the principal firms in the Mansfield district met at the Swan Hotel to discuss the proposed scheme of the General Power Distribution Company with the company's representatives. Mr. Devonshire (of the British Thomson-Houston Company) explained the proposals. Various questions were put as to the cost of the current to consumers, out and out cost, or hire cost of motors, &c. The Derby Town Council will oppose the company's Bill.

## TELEGRAPH AND TELEPHONE NOTES.

**Bolton Telephone Service.**—In response to the complaints of the Bolton Chamber of Commerce as to the unsatisfactory condition of the telephone service, the Post Office authorities have replied stating that in so far as was practicable in the absence of details of specific cases, the matter has been carefully inquired into by the department's surveyor for the district. From a return which has been taken of the trunk traffic at Bolton, it appears that, of the trunk calls originated by subscribers at Bolton, 62·40 per cent. were put through, so far as the department is concerned, in less than five minutes, and 87·21 in less than ten minutes, and, on the whole, there does not seem to be any reason to suppose that a satisfactory service is not given.

**Delays in Australian Telegrams.**—The Postmaster-General of South Australia, Sir Charles Todd, must by this time have realised that the hopes which he expressed in a letter of reply to the protest made by the London Chamber of Commerce, complaining of the delays in the transmission of cable messages to Australia, were over sanguine. In this letter, dated Adelaide, August 31st, 1897, this gentleman, after suggesting that delays are due to various causes and that the lines in the Colony of South Australia were seldom at fault, says that "as a rule messages are transmitted very quickly over the line between Adelaide and Port Darwin, and our difficulties as regards the new code have been completely overcome; I do not, therefore, anticipate any further complaints." With the above opinion before us, it may not be out of place to detail the interruptions and delays which have occurred since the date of Sir Charles Todd's letter, viz.:—

| | | |
|---|---|---|
| September | 6th, 1897. | Port Darwin line unworkable. |
| „ | 17th, „ | „ „ „ interrupted. |
| November | 19th, „ | Both trunk lines cut off from Melbourne. |
| December | 9th, „ | Port Darwin line interrupted for about four days. |
| „ | 15th, „ | Port Darwin line interrupted by floods. |
| „ | 18th, „ | „ „ line working very badly north of Hergott Springs. |
| „ | 22nd, „ | Both South Australian lines between Eucla and Adelaide unworkable for some hours. |
| January | 4th, 1898. | Considerable delay in press messages due to irregularity in the working of the landlines in Australia. |
| „ | 8th, „ | Australian landlines working badly; no cables through from Adelaide. |
| „ | 19th, „ | Cables from Adelaide delayed. |
| „ | 20th, „ | Communication from Adelaide in many cases as much as 24 hours late. |
| „ | 31st, „ | Delay in communication to London, unable to supply usual Adelaide prices. |
| February | 1st, „ | Government wires in Australia working very badly; telegraphic communication between Australia and England greatly delayed. |

These interruptions, it will be seen, are by no means rare, occurring as they do on at least 13 occasions during the last five months. As he is a strenuous opponent to the Pacific cable scheme, a means by which the inconveniences referred to would have been avoided, it is interesting to gauge the value of the opinion so confidently expressed by the Postmaster-General of South Australia. It is widely suggested throughout the press, that a remedy for the above mentioned delays and interruptions will be found in a system of cables, which the Eastern Telegraph Company propose (for certain considerations) to lay to the Cape, and from thence on to Perth in Western Australia; but as this cable will land some 1,600 miles from Adelaide, 2,000 miles from Melbourne and 2,500 miles from Sydney, to say nothing of the 3,000 miles of landline intervening between Perth and Brisbane, it will be seen that the proposed remedy cannot be considered as in the least degree likely to supply the want which is so badly felt, not only in Australia, but in England.

**The Deutsche See-Telegrafen-Gesellschaft.**—We learn that the Emden-Vigo cable, which was laid about a year ago for the above-named company, has again broken down. If, as we have heard, this cable is intended to form the first link of a system which is to put Germany into communication with the United States without touching on English territory, it would seem prudent to duplicate the first section before going any further in the matter, as this is, we believe, the sixth occasion on which this cable has broken down in the space of a year. Such a record is not calculated to inspire much confidence in the minds of the Deutsche See-Telegrafen-Gesellschaft.

**The London Authorities and the Telephone Service.**—Both the Court of Common Council and the London County Council have been discussing in earnest the question of the telephone service. The L.C.C. is to obtain an inquiry into the service through an application for a licence to establish a municipal service for London. The Court of Common Council is applying for an inquiry and will hold a conference of local authorities at the Guildhall into the matter.

### Telegraphic Interruptions and Repairs:—

| Cables. | Down. | Repaired. |
|---|---|---|
| Brest-St. Pierre (Anglo, 1869) | April 6th, 1893 ... | ... |
| West Indies— | | |
| St. Croix-Trinidad ... | Nov. 30th, 1896 ... | ... |
| Curaçao-La Guayra ... | Jan. 5th, 1898 ... | ... |
| Paramaribo-Cayenne ... | Jan. 27th, 1898 ... | ... |
| Amazon Company's cable— | | |
| Parintins-Itacatiara ... | May 5th, 1896 ... | ... |
| Obidos-Parintins ... | Dec. 7th, 1896 ... | ... |
| Saigon-Hong Kong ... ... | Jan. 8th, 1898 ... | ... |
| Para-Maranham ... ... | Jan. 22nd, 1898 ... | Feb. 8th, 1898. |
| Bolama-Bissao ... ... | Jan. 28th, 1898 ... | ... |
| Emden-Vigo ... ... ... | Feb. 7th, 1898 ... | ... |
| **Landlines.** | | |
| Trans-Continental line beyond Masol | March 12th, 1896 ... | ... |
| Cartagena-Barranquilla ... | July 4th, 1896 ... | ... |
| Majunga-Tananarive... ... | Feb. 2nd, 1898 ... | Feb. 5th, 1898. |
| Nicaragua landlines ... ... | Feb. 8th, 1898 ... | ... |

## CONTRACTS OPEN AND CLOSED.

### OPEN.

**Bilbao.**—February 28th. The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Consul at Bilbao, reporting that the provisional board appointed in connection with the electric tramway which it is proposed to lay from Zumarraga to Zumaya, in the province of Guipuzcoa, invite plans and tenders, to be received by February 28th, for the construction and equipment of the line. Further particulars of the conditions of the tenders for the above-named tram line and branch, which together measure 30 miles, may be inspected at the Commercial Department of the Foreign Office any day between the hours of 11 and 6.

**Belgium.**—February 16th. Tenders are being invited by the Société Nationale des Chemins de Fer Vicinaux, of Brussels, for the supply of 38 electric tramcars. Tenders to be sent to, and particulars may be obtained from, the offices of the company, Rue de la Science, 26, Brussels.

**Berlin.**—March 15th. The Municipal Traffic Deputation of the Town Council have opened a competition for the construction of several new electric tramways in that city. Exhaustive details concerning this project are contained in the *Elektrotechnische Zeitschrift* of the 13th inst., which mentions that proposals will be received by the Stadtische Verkehrsdeputation Rathhaus III, Berlin, by March 15th.

**Bristol.**—February 21st. The Electrical Committee want tenders for 214 arc lamp posts. Electrical engineer, Mr. H. Faraday Proctor. See our "Official Notices."

**Canterbury.**—February 23rd. Tenders are invited for the electric wiring and fittings for the Beaney Institute for the Town Council. Specifications, &c., to be obtained at the office of the City Surveyor, 28, St. Margaret's Street.

**Denmark.**—The Formand for Byraadets Udvalg for Elektricitetsvaertet (Sugförer Edv. Lau), of Kolding, are inviting tenders for the supply of (1) the engines and boilers; (2) the dynamos and other electrical plant and apparatus; and (3) the supply and laying of mains required in connection with the projected central electric lighting station in the town. Particulars may be had on applying as above for the sum of 50 krondos (returnable on receipt of *bonâ fide* tender). Tenders addressed as above.

**Denmark.**—March 12th. Tenders are being invited for the supply of the engines, dynamos, accumulators, &c., required in connection with the new central station at Frederiksberg, near Copenhagen. Tenders to be sent to the Frederiksberg Sporveis-og Electricitets Aktieselskab, Gammel Kongerie, 140, Copenhagen V., from whom particulars may be obtained.

**France.**—February 16th. Tenders are being invited by the French Naval Authorities at Toulon for the supply of circuit breakers, rheostats and dynamo wire. Particulars from, and tenders to, Le Bureau du Détail des Approvisionnements de la Marine Nationale, Toulon.

**France.**—March 31st. Tenders are being invited by the Municipal Authorities of Saint Chamond (Loire) for the concession for the lighting of the public streets of the town, either by gas or electricity. Particulars from, and tenders to be sent to, La Mairie de Saint Chamond (Loire).

**Glasgow.**—February 18th. Tenders are invited for the construction of several sections of tramways for the Corporation. Specification, &c., from Mr. John Young, general manager, 88, Renfield Street, Glasgow.

**Hammersmith.**—February 16th. The Vestry want tenders for general stores for the electricity works. See our "Official Notices."

**Harrogate.**—February 24th. The Corporation invite tenders for the supply and erection of vertical steam engine, dynamo, switchboard, motor, overhead conductors, &c., for sewage pumping plant. Mr. Geo. Wilkinson, borough electrical engineer. See our "Official Notices."

**Italy.**—February 16th. Tenders are being invited by the Italian Naval Authorities at Spezia for the supply of a large number of 12-C.P., 16-C.P., 25-C.P. and 100-C.P. incandescent lamps of different voltages. Tenders to be sent to La Direz Torpedine e Materials Elettrica, 1° dip. Marittimo, Spezia, Italy, from whence particulars may be obtained.

**L.C.C.**—February 16th. The London County Council Asylums Committee want tenders for a great variety of sundries. One of the items is for electric lighting sundries for Claybury. Particulars at the office of the Asylums Committee, 21, Whitehall Place, S.W.

**Madrid.**—February 22nd. The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Chargé d'Affaires at Madrid, enclosing copy of a Royal decree announcing that a public auction for the contract for repairing the national submarine telegraph cables during the next five years will be held at Madrid on February 22nd. Further particulars as to the cables in question may be inspected at the Commercial Department of the Foreign Office any time between the hours of 11 and 5.

**Northwich.**—March 5th. The Weaver Navigation Trustees are inviting tenders for the construction and erection of the necessary electric power plant for lighting and working the new swing bridges at Northwich. Current will be supplied by the Northwich Electric Supply Company. Engineer, Mr. J. A. Saner, M.I.E.E. See our "Official Notices" this week.

**Pembroke (Ireland).**—March 5th. The Lighting Committee want tenders for the supply and erection of various plant, machinery, &c., for electric lighting. See our "Official Notices" this week for full particulars. Consulting engineer, Mr. Robert Hammond.

**Plymouth.**—February 21st. The Council want tenders for the erection and completion of a refuse destructor with all necessary flues, fittings, boilers, &c. Borough engineer, Mr. James Paton, Municipal Offices.

**Portsmouth.**—February 22nd. The Corporation want tenders for the supply and erection of Lancashire boilers, feed pumps, mechanical stokers, &c. Consulting engineers, Messrs. Kincaid, Waller & Manville. See our "Official Notices" this week.

**Redditch.**—February 14th. The District Council want tenders for the supply of buildings, gas producing plant, gas engines, alternators, cables, transformers, &c., for the electric lighting of the district. Consulting electrical engineer, Mr. J. A. McMullen. See our "Official Notices" January 28th.

**Rochdale.**—February 19th. The Corporation want tenders for steam dynamos, balancer, and boosters, &c. Engineers, Messrs. Lacey, Clirehugh & Sillar. See our "Official Notices" January 14th.

**Roumania.**—March 15th. Tenders are being invited by the General Direction of the Roumanian Post and Telegraphs in Bucharest for the supply of 56,000 metres of galvanised iron and steel wire.

**St. Helens.**—February 21st. The Corporation want tenders for various plant and machinery, &c., in connection with the proposed electric tramways. See our "Official Notices" January 28th for particulars. Consulting engineer, Dr. J. Hopkinson.

**St. Pancras.**—February 22nd. The Vestry want tenders for dry back marine boilers with superheaters and brickwork seatings. See our "Official Notices" February 4th.

**The War Office.**—April 27th. The Secretary of State for War is prepared to receive offers, competitive designs and specifications for the supply of portable electric search light apparatus. Particulars from the Director of Army Contracts, War Office, Pall Mall, S.W. See our "Official Notices" February 4th.

**Victoria.**—March 21st. The Telegraph Department of the Victorian Government Railways is inviting tenders for the supply of alternating current transformers and one main switchboard. Tenders to the Telegraph Superintendent's Office, Spencer Street, Melbourne.

**Wallasey.**—March 17th. The District Council want tenders for the supply of engine, alternator, exciter, two Lancashire and one water-tube boilers, and condensing apparatus. Engineer, Mr. J. H. Crowther. See "Official Notices" this week.

**Watford.**—March 16th. The District Council want tenders for the supply and erection of various plant for the electric lighting of the district. For details of the seven sections see our "Official Notices" this week. Mr. W. C. C. Hawtayne, consulting engineer.

## CLOSED.

**Blackburn.**—The contract for the 500-kilowatt C.C. steam dynamo for the Council has been placed with Messrs. Siemens-Belliss. The following are the tenders with Belliss' engines:—

| | £ | s. | d. |
|---|---|---|---|
| Electrical Company.. .. .. .. .. .. | 6,500 | 0 | 0 |
| Westinghouse .. .. .. .. .. .. | 4,754 | 0 | 0 |
| Crompton & Co. .. .. .. .. .. .. | 4,666 | 0 | 0 |
| J. A. Holmes .. .. .. .. .. .. | 4,634 | 0 | 0 |
| P. R. Jackson.. .. .. .. .. .. | 4,492 | 0 | 0 |
| Mather & Platt .. .. .. .. .. .. | 4,405 | 0 | 0 |
| Electric Construction Company .. .. .. | 4,384 | 0 | 0 |
| Siemens Bros. .. .. .. .. .. .. | 4,340 | 0 | 0 |

The order for the steam alternator has not yet been definitely placed. Mr. Lacey is the consulting engineer.

**Bradford.**—We understand that the tender of the Westinghouse Electric Company, Limited, has been accepted for the electrical equipment of tramways in this city for the sum of £14,664.

**Brighton.**—The following is a list of the tenders submitted for the completion of the electric lighting, wiring, &c., of the Town Hall. Only those marked * were, says *Daily Tenders and Contracts*, entertained, they being the only tenders complying with the specification, which required samples of materials and fittings to be submitted:—

| | £ | s. | d. |
|---|---|---|---|
| Whipp & Co., Manchester .. .. .. .. .. | 625 | 0 | 0 |
| *A. H. Wood, Army and Navy Mansions, London, S.W. (accepted) .. .. .. .. .. .. .. | 705 | 0 | 0 |
| *H. V. James Mills & Co., Manchester .. .. .. | 860 | 0 | 0 |
| The Nelson Electrical Engineering Company, Nelson .. | 874 | 0 | 0 |
| Lawrence & Blaiberg, London, W. .. .. .. .. | 875 | 12 | 0 |
| *Page & Miles, Brighton .. .. .. .. .. | 899 | 14 | 0 |
| *C. G. Reed & Son, Brighton .. .. .. .. .. | 985 | 10 | 0 |
| *Laing, Wharton & Down, Ltd. .. .. .. .. | 1,010 | 15 | 0 |
| *W. J. Fryer & Co., Ltd., London, W. .. .. .. | 1,223 | 5 | 0 |
| M. Fileman, Brighton .. .. .. .. .. .. | 1,500 | 0 | 0 |
| E. A. Tasker, St. Paul's .. .. .. .. .. | 1,965 | 0 | 0 |

**London.**—The following tenders were sent in for the electric light wiring of the Abbey Mansions, North Block, Victoria Street, S.W. Consulting engineer, Mr. Morgan Williams, C.E.:—

| | £ | s. | |
|---|---|---|---|
| Electrical and General Engineering Co. | 1,656 | 0 | 0 |
| Hill, Gifkins & Co. .. .. .. .. | 1,249 | 14 | 0 |
| H. M. Leaf .. .. .. .. .. | 1,147 | 10 | 0 |
| Drake & Gorham .. .. .. .. | 1,095 | 0 | 0 |
| Townsend, Tamplin & Makovski .. .. | 1,046 | 2 | 6 |
| Laing, Wharton & Down .. .. .. | 991 | 9 | 6 |
| Warburg, Dymond & Co. .. .. .. | 968 | 0 | 0 |
| Belshaw & Co. .. .. .. .. | 909 | 15 | 0 |
| C. A. Hemingway .. .. (accepted) | 838 | 12 | 0 |

Estimated total, with branch wiring for 610 3/22 S.W.G. points.

**London.**—The following tenders were submitted for the electric light wiring of Messrs. Welch, Margetson & Co.'s new warehouse, Moor Lane, E.C. Consulting engineer, Mr. Morgan Williams, C.E.:—

| Name of firm. | Tender No. 1 (Mains and Distribution Boards). | Tender No. 2 (Branch Wiring per point) | | Estimated total for 721 points of 3/22 S.W.G. |
|---|---|---|---|---|
| | | 7/21½ S.W.G. point. | 3/22 S.W.G. point. | |
| | £ s. d. | s. d. | s. d. | £ s. d. |
| H. M. Leaf .. .. | 290 0 0 | 23 0 | 22 0 | 1,183 2 0 |
| Strode & Co. .. .. | 247 0 0 | 30 0 | 21 0 | 1,004 1 0 |
| Townsend, Tamplin and Makovski .. | 273 18 9 | 21 6 | 17 6 | 904 16 3 |
| Belshaw & Co. .. | 230 0 0 | 27 0 | 15 0 | 770 15 0 |
| Spagnoletti and Crookes (accepted) | 270 0 0 | 13 0 | 12 0 | 702 12 0 |

**Newport.**—The contract for the supply of an electric lighting plant for 130 16-C.P. lamps and six 500-watt arc lamps for temporary lighting at Westwood waterworks for the Corporation has been given to Mr. C. D. Phillips, of Newport.

**Stafford.**—The County Lunacy Committee has reported that the Cheddleton Sub-Committee had invited tenders for the installation of the asylum with electricity, upon plans and specifications prepared by Mr. Henry Lea, C.E., of Birmingham, and of the four tenders received the following had been accepted:—Mavor and Coulson, £6,240 (generating and storage plant); Walsall Electrical Company, Limited, £3,195 16s. 6d. (wiring and fittings).

**West Hartlepool.**—It is stated that the following contracts have been given out by the Corporation for electric lighting plant:—Boilers, Anderton & Son; engines, dynamos, switchboard, motor-dynamos and arc lamps, Crompton & Co.; storage battery, Tudor Accumulator Company.

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**Dinner in Honour of Mr. James Dredge.**—A dinner in honour of Mr. James Dredge, C.M.G., Executive Commissioner of the Brussels International Exhibition of 1897, took place on Wednesday night at the Grand Hotel, Trafalgar Square. Sir Albert K. Rollit, M.P., occupied the chair. On behalf of the exhibitors in the British section the chairman presented Mr. Dredge with a beautiful album containing a general view of the exhibition buildings and an illuminated address, to which were appended the signatures of the subscribers.

## THE MAKING OF CHLORIDE ACCUMULATORS.

It is, perhaps, almost unnecessary to say that the company which make the chloride cell is the Chloride Electrical Storage Syndicate, Limited, and the syndicate practically controls the whole of the patents in the world, with the exception of the United States, Canada, and France, where chloride cells are made by allied companies. The original patents were held by the Electric Storage Battery Company, of Philadelphia, from whom the patents for this company and the rest of the world, with the above exceptions, were acquired by the Chloride Syndicate.

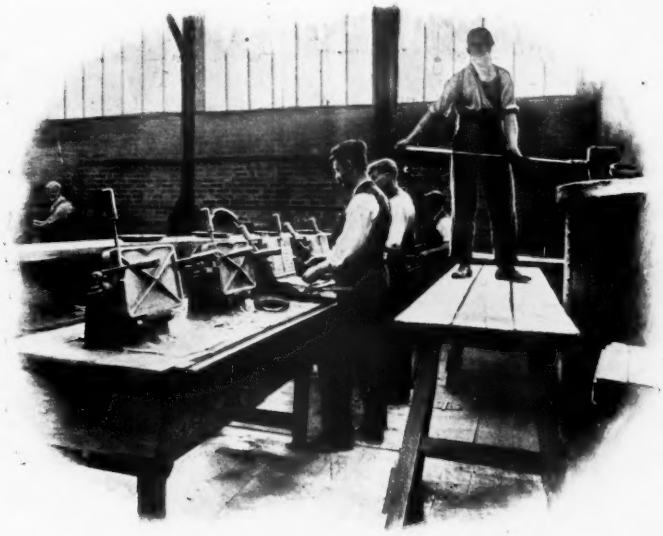


Fig. 2.—Casting Chloride Pastilles.

The home of the chloride accumulator is at Clifton Junction, some five miles from Manchester, and here an old chemical factory has been converted into up-to-date sanitary accumulator works. The conversion has been effected by pulling down old buildings, and erecting substantial, airy, and light ones in their place. The area of the works covers some three acres of ground, the greater portion of which is covered in. The site is most conveniently situated with regard to rail and water, the Bury and Bolton canal being contiguous to the works, and the railway within a stone's throw. There is more order, more cleanliness, and better surroundings than one usually associates with such works. The chairman of the company is Dr. Bowman, who is well known in electrical circles, and the general manager is Mr. G. A. Grindle, who, it is hardly necessary to say, is one of the best known engineers in the profession.

It is perhaps almost an act of supererogation to set forth the many directions in which the chloride accumulator has done distinguished service; but perhaps this account ought to include some reference to the growing use that is being made of the chloride cell. It is not only in electric lighting systems that this cell is performing good work, but in the perhaps more exacting services demanded in a tramway system. Some months ago we had occasion to describe the extensions that had been carried out on the Manchester Corporation electric lighting system, and we then took cognisance of the large battery that had been erected by the Chloride Company. When this battery was put

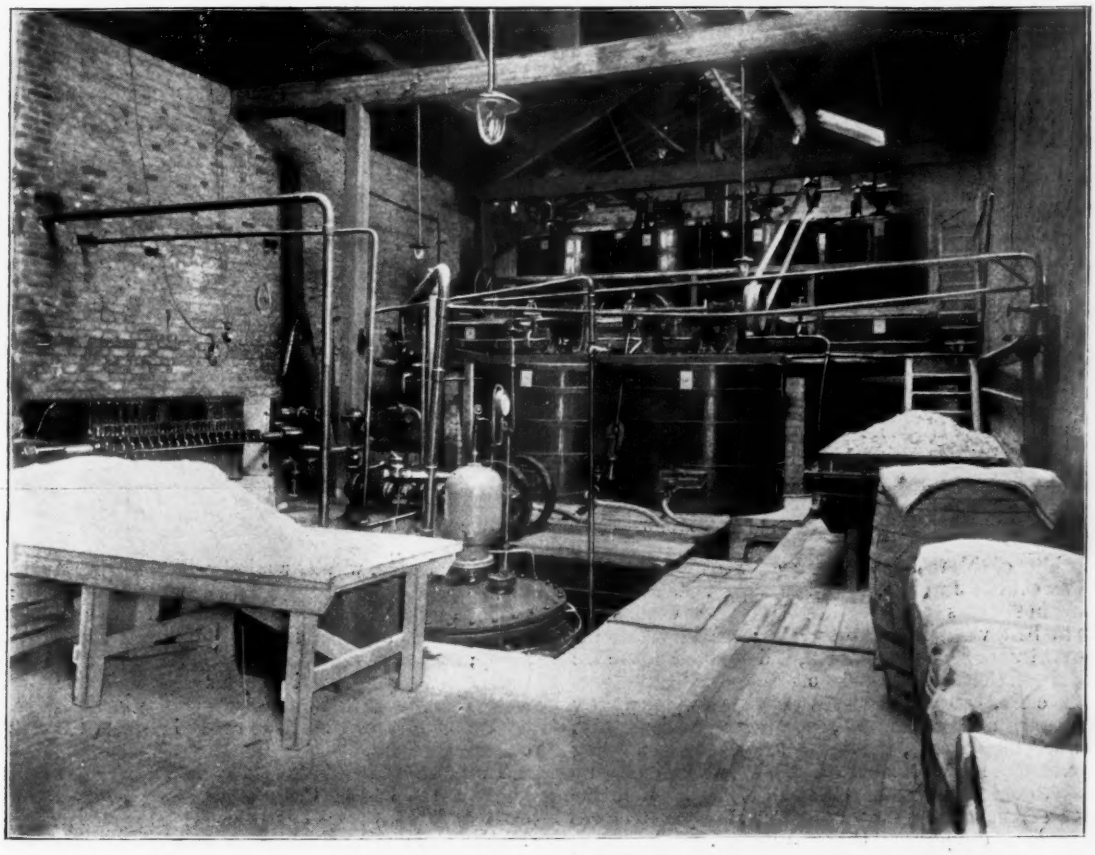


Fig. 1.—The Chloride of Lead Machinery.

down it was probably the largest in the country, and the objects that led to its introduction into the Manchester system were to save running a new feeder; to enable the station to be shut down at night, and to act as a balancing device. In every respect we believe this battery has been entirely successful. Although electric tramways are practically beginning in this country, the chloride accumulator has been intimately associated with some of the lines that have been completed. On the Douglas and Laxey line, this type of cell is used at a half-way house to assist the dynamos and to maintain the pressure; it is also serving similar services on the Snaefell Mountain Railway. At Leeds, the most recently completed tramway system, great reliance is being put upon chloride accumulators, where they are arranged in two substations.

The position attained by the chloride accumulator in the electrical industries is sufficient justification for giving some account of the various processes that attend its manufacture.

The name of the cell is obtained from the use that is made of chloride of lead which is employed in the negative plate, the positive plate being made up of ordinary metallic lead. It is, of course, the negative plate that constitutes the chief feature of this type of accumulator, and in accordance with the fitness of things we ought to describe the methods that are followed in the various stages of making the plate.

The first step is the manufacture of chloride of lead, which is carried on in an entirely separate department of the works. Litharge, which is the basis of the product, is dissolved in large vessels in which mechanical stirrers are being constantly rotated. These vessels are shown in the background of the illustration of the chloride room (fig. 1), and it will be observed that the stirrers are connected by suitable gearing and belting to shafting. The litharge is dissolved by means of acetic acid, which gives the resultant compound of acetate of lead. After the lead acetate has been drawn off and allowed to settle, it is then precipitated by means of

Fig. 3.—Framing the Pastilles.

The making of this well-known cell is carried on in extensive works at Clifton Junction, near Manchester. The process followed in the construction of this accumulator enables the works to be divided into two sections: one in which the mechanical work is done on the cell, and the other where the chemical and electrical manipulations are performed. There are, of course, other departments that are only indirectly associated with the cell making, such as the wood working, mechanics' departments, the boiler house, the generating station, the gas making, and a portion of the works is given up entirely to the manufacture of chloride of lead. With the exception of purchasing the raw material, every part of the accumulator is completed at Clifton Junction.

It is hardly necessary to say that both the manufacture of the positive and the negative plates call forth some very interesting and pretty operations, and by means of the illustrations we shall be able to demonstrate some of them.

hydrochloric acid, which practically gives us chloride of lead. The process is not quite so simple as we have described; for instance, when the compound has reached the acetate of lead stage it is carefully analysed, so that its nature is known to a nicety; moreover, the solution of chloride of lead is passed through a filter press, which squeezes out the acetic acid and leaves chloride of lead in the shape of whitish cakes. At one end of this room are large ovens in which the cakes of chloride are dried.

The chloride of lead next makes its appearance in what is known as the Pastille Casting Department, the name being derived from the special shape in which the chloride is used. In this room are large iron pans in which the chloride of lead is melted. The pans are protected by means of refractory linings, and a seal of lead, some inches in thickness, protects the bottom; they are capable of holding between two and three tons of molten chloride, and are heated by

Fig. 5.—Casting Negative Sections.

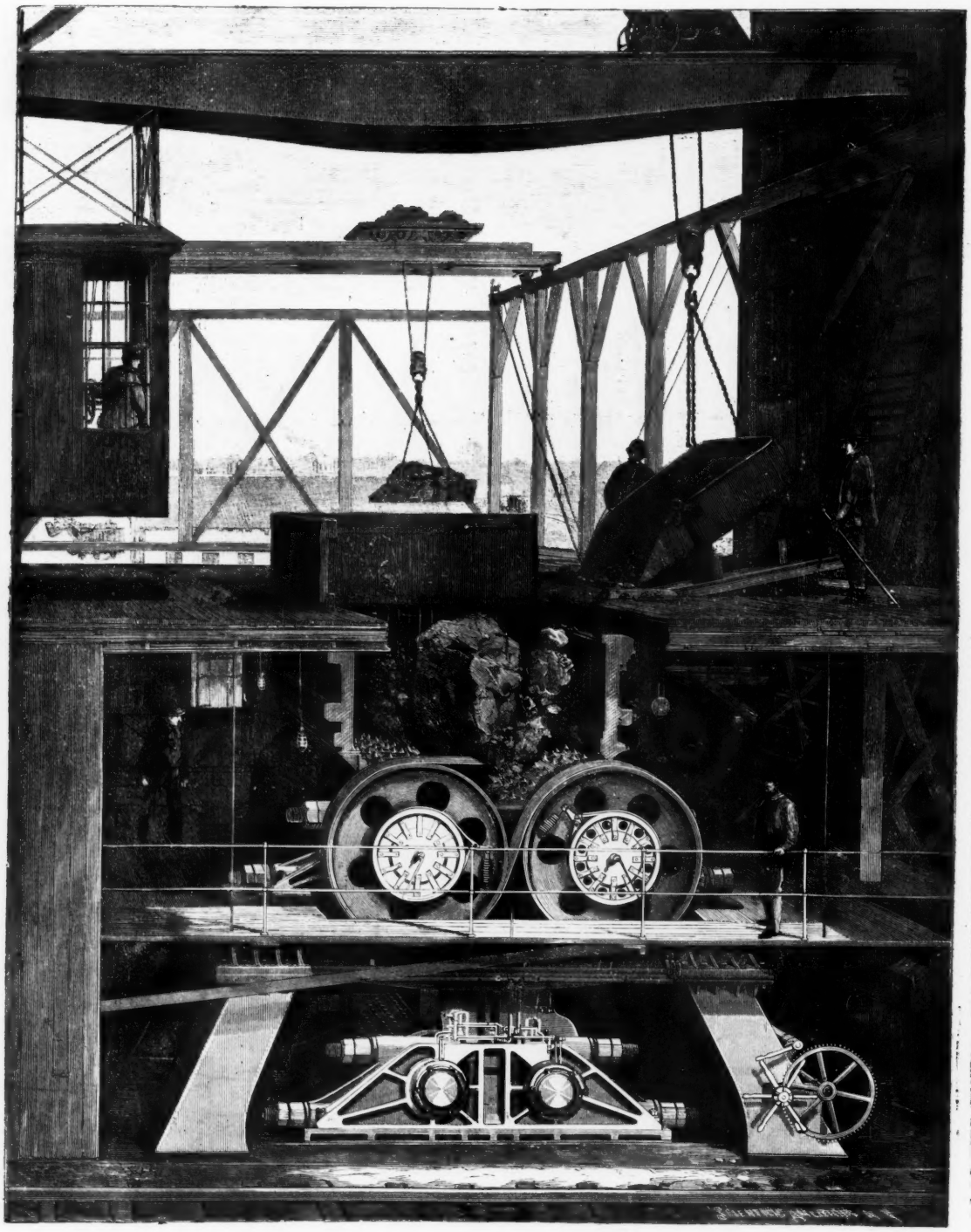
cast in moulds into small hexagon pastilles, suitable for framing. The operation of ladling the chloride and casting the pastilles is shown in fig. 2. The pastilles are then carried away to be framed, and this operation is distinctly interesting. The pastilles are arranged in the bottom half of a plate mould, the top half of the mould being permanently fixed to the top side of a hydraulic press. After the pastilles have been arranged on the mould, it is placed in position on the ram by means of stops, and water being admitted to the ram chamber, the press is closed, and the top half of the mould comes down on to the bottom half. The next operation is to inject molten lead under pressure to fill in the interstices left in the mould. This is done through a nozzle, which by means of a screw connects the molten lead chamber to the mouth of the mould. Compressed air is then admitted into the top of the lead chamber with the result that lead is forced into the mould, completely filling it and bedding in the pastilles. Fig. 3 shows one of the lead presses and boys placing pastilles in the lower half of the mould. The lead chambers are all submerged in a large pan of molten lead, four chambers and presses being arranged round each lead pan. The compressed air is delivered into the lead chambers at a pressure of 150 lbs. per square inch. The operation of the lead press is sufficiently safeguarded to prevent pressure being applied to the lead chamber until the press has been completely closed. Fig. 3 shows the operation of framing pastilles, the boys on the right of the illustration, whose expression has been lost in the complicated process of making the block, are fitting the pastilles into the lower half of the mould, and the men in the background are working the lead press. The next process is to trim the plates, and after this they are taken to the reduction tanks (shown in fig. 4) where they are set up alternately with rolled zinc plates, with the result that the chlorine in the chloride of lead pastilles leaves the pastille uniting with the zinc and forming chloride of zinc in the tank, the final state being that each pastille is converted into one of pure spongy lead. After a process of washing, the plates are then given

Fig. 4.—Reduction Sheds.

Dowson gas. The chloride is put into the pans with a small percentage of zinc, and becomes perfectly fluid at about 600° C. It is ladled out by means of plumbago ladles, and a hydrogen bath to ensure absolute freedom from all trace of chlorine. That operation practically completes the making of the negative plate, they are not quite finished with, how-

ever, for they are then passed on to the plumbers, who cast them up into sections ready for sending out. Quite a simple operation is the casting up, and simply depends upon putting the plates in a specially shaped mould, in which molten metal is poured; the process of casting the negative sections is shown in fig. 5.

(*To be continued.*)



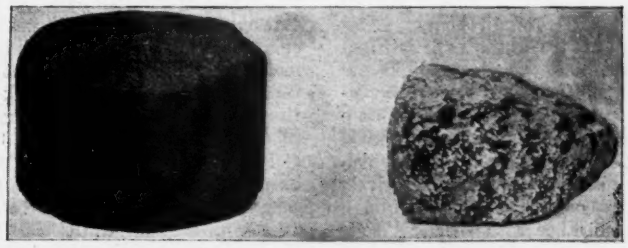
THE GIANT ROLLS AT THE EDISON MAGNETIC CONCENTRATING WORKS.

## THE EDISON MAGNETIC CONCENTRATING WORKS.*

BEFORE describing the remarkable process of crushing and magnetic separation at Mr. Edison's concentrating works in the mountains of New Jersey, it will be well to speak of the elaborate system of prospecting which was carried out to determine the location of the various bodies of low grade iron ore which it is proposed to work by the new process. In iron mining, just as in gold mining, there is a limit to the grade or richness of ore which it is profitable to work in the existing state of the art. Hence the prospectors, who for many years have worked over the Eastern iron ore districts, have made no record of the existence of deposits which were not fairly rich in iron. As the Edison process was designed to render the hitherto neglected low grade ores commercially profitable, it was necessary to make a systematic prospect of the belt of magnetite deposits. The work was done by means of the dipping needle, and the survey was the most complete ever carried out. It embraced a strip of country 25 miles

* *Scientific American.*

wide, reaching from the Canadian border to the mountains of North Carolina. Several corps of surveyors ran lines across the magnetite belt at intervals of a mile, and wherever the dip of the needle showed indications of ore, a more thorough search of the locality was made. The results were plotted on a map, which is the most unique and thorough work of its kind in existence. When this was completed, the company proceeded to purchase or lease the most desirable properties, their holdings at present amounting to some 16,000 acres.



A Briquette, 68 per cent. of Iron. Fig. 2. A Lump of Iron Ore, 20 per cent. of Iron.

The New Jersey and Pennsylvania Concentrating Works are located on the site of the old Ogden mines, one of those many abandoned iron mines of New Jersey from which the veins of richer ore have been worked out during the century or more in which iron mining has been carried on in this district. The body of ore averages about 200 yards in width, and extends for a distance of over two miles. The average richness of the ore is about 20 per cent. of iron. It should be mentioned that although the works at Edison witnessed the first attempt to carry out magnetic concentration on a commercial scale, Mr. Edison had conducted a series of preliminary experiments at Llewellyn Park, N.J. The operations at Edison commenced about six years ago, and the characteristic energy and lavish expenditure with which they have been carried on have resulted in the present enormous and extremely interesting plant.

The visitor to Edison who is familiar with the scope of Mr. Edison's inventive genius — and who is not? — in the design and perfecting of such delicate or complicated devices as the incandescent lamp, the phonograph, or the vitascope, will find that in the totally different fields of mining and milling, with their massive machinery and vast operations, Mr. Edison has shown a characteristic originality and freedom from the trammels of tradition. This is evident, not merely in the application of an entirely new system of concentration, but in the preliminary work of mining and crushing, where, surely, most men would have been content to follow the beaten track.

To carry out the process of magnetic separation called for the design of an entirely new plant in itself, and involved long years of patient and costly experiment; and, with a view of cheapening the work of getting out the rock and crushing it to the desired fineness for the magnets, an entirely new method of quarrying and crushing was devised and put into successful operation.

The works are situated approximately midway of the length of the deposit. A system of tracks runs from the crusher house to two powerful steam shovels which are working their way into the ore bed in two different directions. One of these weighs 60 tons and the other—a magnificent fellow weighing 93 tons—is the biggest of its kind ever built. In getting out the rock ready for the crushers, no attempt is made to shatter it to the usual size of, say, 100 lb. lumps by the free use of dynamite. The latter is used merely to loosen up the rock sufficiently for the great shovel to tear it loose and load it on the cars. Consequently it is frequently dug out of the cut in solid masses, weighing as much as five and even six tons apiece, and sent to the rolls in this shape. A double track, with a switch at the far end, runs through the cut on a slight up grade. The empties are pushed up and allowed to run back, by gravity, past the shovel, where the rock is deposited on 5-ton skips, of which there are two to each car. The tracks run on each side of the crusher house, and here the skips are picked up by a pair of 10-ton electric travelling cranes, and placed on an inclined table in front of the hopper above the "giant rolls." At the foot of this table is a revolving cylinder controlled by the operator, over which the material is fed to the rolls. This arrangement is clearly shown in the engraving on the previous page, where a load is shown falling from the skip into the rolls.

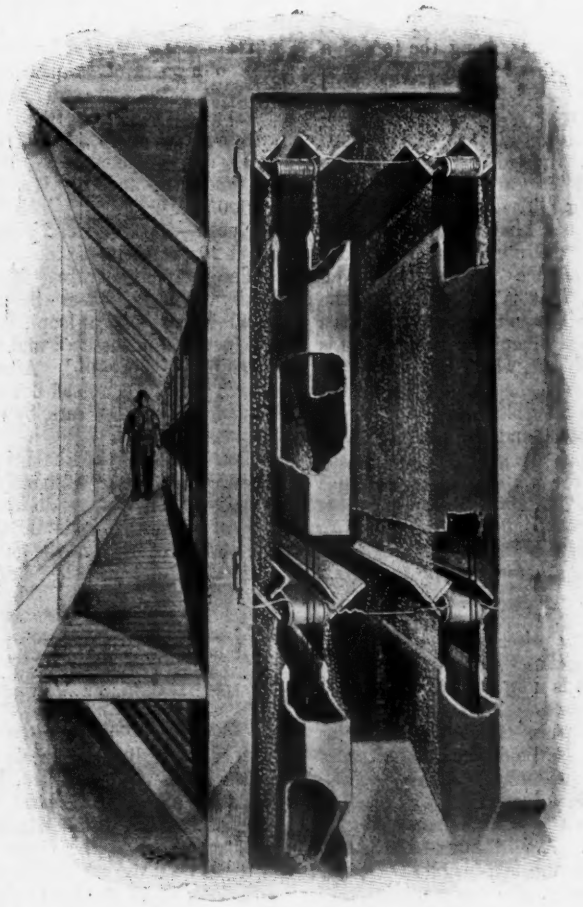


Fig. 1.

The giant rolls are what might be called the spectacular feature of the whole plant, and to see them seize a 5-ton rock, and crunch it with less show of effort than a dog in crunching a bone, gives one a vivid sense of the meaning of momentum—for it is momentum that does the work. The rolls are 6 feet in diameter, with a 6-foot face, and when they are running, the masses in motion weigh about 70 tons. They are spaced 7 feet 2 inches between centres, having a 14-inch space between their faces. The faces are covered with heavy cast-iron "slugger plates," which consist of a soft backing, with chilled 2-inch knobs. There are also two lines of massive knobs on opposite sides of one roll, which project 4 inches from the face. It is these which strike the smashing blows upon the large masses of rock, and break them up for the smaller knobs to act upon. The rolls are run at a normal circumferential speed of 3,500 feet a minute, and it is the energy stored up in the 70-ton mass at this speed which does the work. The rolls are driven by a belt, which serves to speed them up to the desired velocity, but is not depended upon to do the crushing. The pull of the belt is transmitted to the rolls by means of a strap brake acting on the neck of the rolls—as shown in the engraving—which is adjusted by means of a coil spring.

The 93-ton shovel and giant rolls combined do the work,

which, in the ordinary methods of mining, is done by a freer use of dynamite, and it is just here that the first notable economy of this plant is realised.

The rock falls now upon the "intermediate rolls," shown immediately below the "giant rolls." They are 4 feet in diameter, have a 5-foot face, and are covered with knobbed plates. Their faces are 7¼ inches apart. The two sets can handle 3,000 tons of rock in a day of 10 hours. After passing through the intermediate rolls the rock is lifted by a wire rope elevator, in which the usual side links are replaced by side ropes in sets of four—an Edison invention, designed to reduce weight and lubrication and facilitate fast running—to a set of 36-inch rolls faced with chilled corrugated iron plates, the aperture between faces of which is about 2½ inches. Unlike the giant rolls, these are positively driven; but to avoid breakage a connection is made through a split wobbler, which is held together with shearing bolts whose total cross section is such that they will shear off before any breaking strain can be transmitted to the rolls. From the first set of 36-inch rolls the rock passes down to a second set, which is similar to the first, but spaced with a 1½-inch aperture. From these it falls into a third set, which are 24 inches in diameter, with a 20-inch face. These are not positively fixed, but are kept in place by coil springs.

By this time the rock has been crushed to a size of not over ½ inch. It falls on to an elevator which carries it to the top of the "drier," a structure 9 feet square and 50 feet high, which is filled with a series of cast-iron plates 7 inches wide, which reach across the interior from wall to wall, and are arranged one above the other at an angle of 45°, the successive plates facing in opposite directions. The ore is then elevated to a conveyor which runs along the top of a stock house, 75 feet wide by 300 feet long, whose storage capacity is 16,000 tons.

From the stock house the material is carried to the three-high rolls in the concentrating mill. This consists of three rolls, the centre one of which turns in fixed bearings, while the upper and lower rolls are carried in bearings which are free to slide vertically in the housing. The lower roll is driven through a shearing wobbler, of the kind already described, and the bearings at each end of the upper and lower rolls consist of loose sleeves, on the outside of which are seven grooves. Around the grooves, that is to say, below the grooves of the lower sleeve and over the grooves of the upper sleeve, is wound an endless ½-inch wire rope, which is finally carried up over a single sheave, which is acted on by a pneumatic piston. By this means the strain on the rope, and therefore the pressure of the movable rolls on the centre fixed roll, may be closely regulated, and an elastic adjustment is provided which removes all danger of breaking the rolls. The ore is fed between the upper and middle rolls and returned between the middle and lower rolls. The faces of the three-high rolls are smooth, and they are trued up in place when worn by means of a removable tool carriage mounted on the housing. There are four sets of these rolls in all.

The next step is the screening, which is carried on over 10 sets of 14-mesh screens. The rejections are sent back for recrushing in the three-high rolls, and the material which passes through the screens is now ready for the process of magnetic separation.

This process, which takes the place of what is known as the jig process of concentration, is the distinctive feature of the Edison plant. The crushed material is allowed to fall in a thin sheet in front of a series of magnets, which deflect the magnetic particles, but allow the non-magnetic rock to fall in a practically vertical line. A thin knife-edged partition board separates the magnetic and non-magnetic streams, technically known as, respectively, the concentrates and tailings, the concentrates being taken to the drier and subjected to further screening and magnetic separation, and the tailings, in the shape of sand, being sold as building sand in the open market. The latter, on account of its sharpness, is in great demand, and the company readily disposes of all that the works produce.

There are three sizes of magnets: The 12-inch, the 8-inch and the 4-inch. The crushed ore is first allowed to fall in front of a series of three 12-inch magnets (Fig. 1). The tailings, or the crushed particles of rock which are not drawn over by the magnets, are allowed to go to the sand heaps, while the concentrates, which have been drawn out of the falling stream by the magnets, are carried to a drier or sent back to the three-high rolls for recrushing. The dried concentrates are then passed through 50-mesh screens and allowed to fall in front of a series of three 8-inch magnets. The tailings again go to the sand heap and the concentrates are taken to what is known as the dephosphorising room, where they are treated by a special process, invented by Mr. Edison, for reducing the phosphorus. From this room the concentrates are allowed to fall in front of a series of 4-inch magnets, the tailings being sent to the sand-heap and the concentrates being taken back for recrushing or being stored in concentrate stock houses. The stock in these houses carries a percentage of 68 per cent. of iron.

It was at this point in the process that a difficulty was encountered which called for an extended series of experiments and much costly work before it was overcome. The process of smelting in the blast furnaces demanded that, for the best results, the ore should not be delivered in the finely divided state which characterised the concentrates from the Edison plant. It was necessary to furnish the material to the furnaces in a condition which would allow the furnace gases to act upon it to the best effect. The Edison concentrates, on account of their fine subdivision, would be apt to choke the furnaces and prevent the rapid reduction of the ore.

In order to meet this requirement, it was decided to compress the concentrates into briquettes (fig. 2) and deliver them in this form to the blast furnaces. A complete briquetting plant was therefore designed, which has fulfilled all requirements. The concentrates are carried to a mixing house, where a suitable binding material is added, the mixture being carried by means of a trough conveyor in front of a series of briquetting machines. The mixture is forced into dies and compressed in them by means of three plungers, acting in rotation. The first fills the die under a pressure of 800 lbs. to the square inch; the next plunger exerts a pressure upon the briquette of 14,000 lbs. to the square inch; and the last plunger exerts a pressure of 60,000 lbs. per square inch. Two sizes of briquettes are produced—3 inches and 2½ inches; the larger sizes weighing about 20 ozs. each.

The briquettes are carried by a bucket conveyor to the baking furnaces, where the conveyor passes up and down through five vertical loops, the briquettes being retained in the furnace for one hour and nine minutes, and exposed to a temperature of 500°. After they have been thoroughly baked, they are unloaded on to a conveyor, which carries them to the railroad cars, by which they are taken direct to the blast furnaces.

The behaviour of the briquettes in transit and at the furnaces has been eminently satisfactory. They do not absorb moisture, they do not break in handling and they present sufficient voids in the blast furnaces to insure a complete circulation of the gases around them for smelting.

An analysis of the briquettes shows the following results:—

| | Per cent. | | Per cent. |
|---|---|---|---|
| Iron | 67 | to | 68 |
| Silica | 2 | to | 3 |
| Alumina | 0·4 | to | 0·8 |
| Manganese | 0·05 | to | 0·10 |
| Phosphorus | 0·028 | to | 0·033 |
| Binding material | ... | to | 0·075 |

with traces of lime, magnesia and sulphur.

It will naturally be asked, What results have the Edison briquettes shown at the blast furnaces when tested in actual practice? This was determined in 1897, by a trial which was carried out at the Crane Iron Works, Catasauqua, Pa. In these tests various percentages of briquettes were tried in a furnace, which produces an average of 105 tons of pig per day, when using the ordinary burden. The test was started with 25 per cent. of briquettes, and extended over five days, 100 per cent. of briquettes being used on the last day. With 25 per cent. of briquettes, the output was 104 tons of pig, and with 100 per cent. of briquettes the output rose to 138½ tons per day.

From a study of these figures the reader will see that the yield of pig is largely increased by the use of the briquettes over that secured by the use of the usual ores. Moreover, the trial proved that the consumption of limestone is reduced from 30 per cent. to 12 per cent. of the charge of ore, with a corresponding reduction in the quantity of fuel used.

The question has frequently been asked: How can this system of concentration be made commercially profitable with its elaborate plant and its frequent rehandling of the material? The answer is, that the principle of labour saving, by the adoption of automatic appliances, which has enabled American industries to compete successfully against the world, is here carried out to its fullest development in every part of the works. In the mining, with its giant 83-ton shovel; in the "giant rolls" crushing; in the elevators running at a speed of 250 feet per minute; and in the system of magnetic separation, there is a minimum of manual and a maximum of mechanical labour.

Costly and elaborate as the plant may be, it is noteworthy that about 5,000 tons of ore per 20 hours can be mined, crushed and concentrated with a working force of only 125 men per shift. From the time the deposit of ore is loosened by blasting ready for the steam shovel to the time when the concentrated result is shipped on the cars in the shape of briquettes ready for the blast furnaces, the material never once calls for manipulation by hand.

Herein lies the promise and potentiality of this latest and most radical development in the mining and metallurgy of iron.

## NOTES.

**The General Electric Company.**—On Saturday evening last the staff of the General Electric Company, Limited, held its eighth annual dinner and smoking concert in the Empire Room of the Trocadero Restaurant. Some 160 ladies and gentlemen were present, the guests being numerous, and more or less well known in electrical circles. In proposing respectively the toasts of the "Guests" and the "Staff," Mr. Gustave Byng and his brother Max developed a talent for witticisms which would have done credit to Scotchmen; and Mr. Bevis, in reply to the second toast, gave an impromptu address on three-phase working which took all the scientists present by surprise at the very simplicity of the system. The banquet was followed by a well-arranged smoking concert, and the humorous ditties, especially those of a cerulean hue, had an immediate effect upon a certain transient luminous body, which, uneasy during the early hours of the evening, speedily found peace and happiness in Paradise regained. At the time we made the acquaintance of Mr. Gustave Byng, some 16 years since, he had been guilty of reading a paper before a society which shall be nameless, and in a place where he would scarcely venture now, and his staff consisted of his brother and an office boy. To-day the General Electric Company's employés number some 1,600 all told, and it is not a little curious to observe how the figures 1 and 6 enter into this brief notice of a successful firm. Employers (and here we take the opportunity of including Mr. Hirst, who has just returned to convalescence after a serious illness) and employed, are alike to be congratulated on the gigantic undertaking which has been evolved from such a small beginning.

**The Glasgow Technical College Electrical Engineering Laboratory.**—Owing to the liberality of Mr. George Weir, late of the Holm Foundry, Cathcart, who resigned his directorship of the Technical College when he went to Australia, the above laboratory has recently been presented with a delicate Sullivan's universal galvanometer for the measurement of voltages, currents, and resistances. This galvanometer, as we have already pointed out, possesses several novel qualities, and is equally well suited for use on board a telegraph ship and a laboratory on shore.

**Smoking Concert.**—A staff smoking concert of the City of London, Metropolitan, and London Electric Lighting Companies will be held at the Freemason's Tavern, Great Queen Street, Holborn, W.C., on Friday, February 18th, at 7.30 p.m. Hon. secretary, Mr. A. W. Whieldon, 64, Bankside.

**Electric Power from the Shannon.**—It is stated that a company has been formed to utilise the water power of the Shannon for the development of electricity. The directors of the company, which is called the Shannon Electric Power Syndicate, Limited, are Lord Lurgan (chairman), Colonel Sir Gerald Dease, J. F. Bannatyne, D.L., Vere Ward Brown, and Richard W. Booth. It is proposed to construct a canal from a point above Castleconnell to the outlet below Doonass, to provide for storage of a certain volume of water in Lough Derg during the summer, and the company are in communication with the Limerick Fishery Board, so that fishery rights on the river may not be interfered with by the intended scheme.

**Royal Institution.**—At Tuesday's meeting the special thanks of the members were returned to Mrs. Tyndall for her liberal donation of £1,000, presented in the name of the late Dr. John Tyndall, D.C.L., F.R.S., for the promotion of science. Thanks were also returned to Sir Frederick Abel, Sir Andrew Noble and Prof. Dewar for donations to the fund for the Promotion of Experimental Research at Low Temperatures. It was announced that the centenary of the Royal Institution would be celebrated next year.

**Municipal Electrical Association.**—Mr. A. B. Mountain, the secretary of this association, informs us that at a meeting of the Council of the Municipal Electrical Association, held at the Westminster Palace Hotel on Friday, the 28th ult., Mr. A. H. Gibbings was (as stated in the Electrical Review last week) elected president for the year 1898. It was decided to hold the Convention in London on June 8th, 9th, and 10th, papers having been arranged upon the following subjects: Management of Electrical Undertakings; Repayment of Loans and Appropriation of Profits; Uniformity of Plant and Apparatus; Electric Traction; The Use of Accumulators in Connection with Lighting and Traction Systems; Switchboard Apparatus; Auxiliary Apparatus; Stand-by Supply. Mr. J. E. Stewart, of Derby, was elected a member of the council, and the following applications were considered and approved. Elected as members: T. A. Chamen, Glasgow; J. E. B. Thornhill, Taunton; H. W. Clayden, Morley; T. H. Minshall, Croydon; A. L. C. Fell, Sheffield; Electric Lighting Committee, Stockport; Electric Lighting Committee, Morley. Elected as associates: D. McFarlane McLeod, Aberdeen; P. S. Thompson, Huddersfield; W. N. Legge, Halifax; A. Sugden, Halifax.

**City and Guilds of London Institute.**—The students of Finsbury Technical College will hold their annual conversazione at the above College on the 18th inst. Dr. Thompson has promised to lecture on "Wireless Telegraphy." Mr. Ives will give an exhibition of colour photography, and glow-lamp making will be demonstrated by Mr. Robertson.

**The Royal Society.**—The following was among the papers to be read before this society yesterday afternoon: W. G. Rhodes.—"Contributions to the Theory of Alternating Currents."

**Appointment Vacant.**—The Crown Agents for the Colonies want an electrical engineer in connection with the working of an electric light plant at Lagos, West Coast of Africa, for six months at £25 per month. See our "Official Notices."

**Coventry Technical Institute.**—Prof. Ayrton gave the address at the annual meeting and prize distribution in connection with the Coventry Technical Institute, on Friday. He urged that British manufacturers should be more enterprising in inducing wants in the people. He referred to the progress of electrical traction in America, and remarked that while the steam locomotive had given way to the electric motor on American modern overhead railways, the use of electric traction on the underground railway in London, where it was of more pressing necessity, was only under consideration. The substitution of electric traction for horse traction in the streets might interfere at first with the employment of some people, like stablemen, harness makers or corn dealers, but ultimately the number of people employed by the practical application of scientific principles in the development of electric traction, would certainly be enormously increased.

**Webb Testimonial.**—The executive committee are now issuing to contributors resident in the United Kingdom and Ireland invitations to the Presentation Reception which will be held at 9.30 on Monday, the 21st, at the Whitehall Rooms of the Hotel Metropole, immediately after the dinner already announced.

**Northern Society of Electrical Engineers.**—The annual dinner of this society is to take place at the Grand Hotel, Manchester, on Thursday, 17th inst., Mr. Raworth presiding.

**Lectures.**—A lecture on "Earthquakes and Other Movements of the Earth's Crust" was delivered by Prof. John Milne, F.R.S., on 3rd inst., before the Wolverhampton Literary and Scientific Society.

At the Wakefield Mechanics Institution, on Monday last week, Mr. H. Scholey delivered a lecture on "Some Modern Applications of Electricity." The lecturer showed numerous experiments in electric lighting, transmission of electrical power, electric welding and smelting, and electro-deposition of metals, and interest was added to his remarks by several lantern slides, showing the progress which had been made in electric lighting and traction within the last seven years. Mr. Scholey had the loan of apparatus from the General Electric Company, the Lithanode Company, Mr. F. J. Borland, Messrs. Cuttriss Wallis & Co., and the Electric Metal Working Syndicate.

Before the Glasgow Architectural Association on 25th ult., Mr. W. B. Sayers delivered a lecture on "Electric Light, Heat and Power: their Efficient Installation and Cost."

At a meeting of the Aberdeen Mechanical Society in Robert Gordon's College, on 1st inst., Mr. Alfred Blackman, city electrical engineer, read a paper on "Public Electricity Supply."

**Obituary.**—We hear with deep regret of the death of Mr. G. K. Winter, F.R.A.S., which occurred at Madras on January 17th. Mr. Winter joined the Madras Railway Company in the year 1864, and had, therefore, completed a long period of service in India. He was telegraph superintendent of the Madras Railway Company from its very commencement. To him that company was indebted for its "block" system. He had several patents for block signalling instruments, and his system was employed not only on the Madras, but other railways in India, New Zealand, and South America. His latest invention was the improvement of the electrical block ticket service apparatus which is now being taken up. We learn that experiments with his inter-communication system are now being conducted in England, several carriages being now in progress of fitting up for the purpose of a Board of Trade inquiry. Previous to going out to India, he was assistant to Mr. W. T. Ansell, in Ireland, for the Electric and International Telegraph Company. The deceased gentleman was a member of several electrical and other scientific institutions, and 25 years ago he contributed a paper to the British Association on "The Use of Electro-magnetic instead of Electrostatic Induction in Cable Signalling." He was a valued contributor to the ELECTRICAL REVIEW as long ago as 1872. Mr. Winter was in failing health last year, and came home for a few months' leave. He returned to India feeling better, but he had only been back on Indian soil a couple of months when the end came.

## FORTHCOMING EVENTS.

1898.

Friday, February 11th.—Second day of the annual general meeting of the Institution of Mechanical Engineers, at 25, Great George Street. Discussion on Mr. Philip Dawson's paper on "Mechanical Features of Electric Traction." A paper and discussion on "First Report to the Gas Engine Research Committee; Description of Apparatus and Methods, and Preliminary Results," by Prof. Frederic W. Burstall.

Physical Society (rooms of the Chemical Society, Burlington House). Annual General Meeting at 5 p.m.—Address by the President. After which at an Ordinary meeting: "On Electro-magnetic Induction in Plane, Cylindrical and Spherical Current Sheets, and its Representation by Moving Trails of Images," by G. H. Bryan, M.A., F.R.S.

At 9 o'clock. Royal Institution, Albemarle Street, W.C. "The Metals used by the Great Nations of Antiquity," by J. H. Gladstone, Ph.D., D.Sc., F.R.S., &c.

At 8 o'clock. Institution of Civil Engineers (Students). "Protection of Power Transmissions from Lightning," by J. T. Morris.

Monday, February 14th, at 8 o'clock. Northern Society of Electrical Engineers, at Palatine Hotel, Victoria Street, Manchester. Paper by Mr. J. G. Statter, on "Electric Cranes."

Yorkshire College Engineering Society. "The Steam Turbine Engine, and its Applications," by J. D. Baillie (C. A. Parsons & Co.).

Latest date for Redditch Corporation electric lighting plant tenders.

Wednesday, February 16th.—Liverpool Engineering Society, Royal Institution, Colquitt Street. Paper by Dr. J. H. T. Tudsbery, M.I.C.E., on "Engineering Survey Work."

At 8 o'clock.—Society of Arts, "The Protection of Industrial Property," by J. F. Iselin, M.A., LL.M.

At 7 o'clock.—Third of Prof. Thompson's course on "Electro-deposition," at the City and Guilds Technical College, Finsbury, E.C.

At 12 o'clock.—The last of Mr. Mervyn O'Gorman's three lectures on "The Design and Testing of Power Cables for Specific Purposes," at the Central Technical College.

At 7.30 p.m.—Institution of Electrical Engineers. Students' meeting, Mr. F. K. Jewson will read a paper on "Telephones and Telephonic Apparatus."

Thursday, February 17th, at 8 o'clock. Chemical Society, Burlington House. Papers to be read:—"Some Lecture Experiments," J. Tudor Cundall, B.Sc. "Observations on the Influence of the Silent Discharge of Electricity on Atmospheric Air." W. A. Shenstone and W. T. Evans.

At 7 o'clock. Annual dinner of the Northern Society of Electrical Engineers at the Grand Hotel, Manchester. Mr. J. S. Raworth will preside.

Friday, February 18th, at 6.30 p.m.—Institution of Electrical Engineers. Students' visit to the generating stations of the St. Pancras Vestry. Applications to join this party should be made at once to the Students' Hon. Sec. (Mr. S. Grant, 28, St. Mary Abbot's Terrace, W.)

Finsbury Technical College Conversazione. Lecture on "Wireless Telegraphy," by Dr. S. Thompson, &c.

At 7.30 p.m. Staff smoking concert of the City of London, the Metropolitan, and the London Electric Lighting Companies, at the Crown Room, Freemason's Tavern, Great Queen Street, Holborn, W.C. Chairman, Mr. P. W. D'Alton.

Tuesday, February 22nd.—The Federated Institution of Mining Engineers, 26th general meeting at Newcastle-upon-Tyne. Various papers on mining matters are to be read, and among those to be open for discussion are the following: "Light Railways," by Mr. Leslie S. Robinson. "A One-rail or Trestle System of Light Railway," by Mr. Fred. J. Rowan. "On Some Dangers attending the Use of Steam Pipes," by Mr. A. L. Steavenson. "Machine Coal-mining in Iowa, U.S.A.," by Mr. H. Foster Cain. "Latest Developments and the Practical Application of Alternating Multiphase Machinery for Power Transmission," by Mr. Walter Dixon. Visits will be paid to the Telegraph and Telephone Departments at the General Post Office, Mr. A. W. Heaviside, Superintending Engineer.

Wednesday, February 23rd.—Second day of the Federated Institution of Mining Engineers. Various excursions, including visit to the works of Ernest Scott & Mountain, Limited, Newcastle-on-Tyne.

## CITY NOTES.

**Cambridge Electric Supply Company, Limited.**

This company continues to show most striking progress, and it has now reached the prosperous state indicated by a 6 per cent. dividend. We have more than once pointed out the difficulties that this company has to contend with in the shape of a curious load, and the success achieved under the peculiar conditions prevailing in Cambridge amply demonstrates the soundness of electricity supply business generally. The increase in the year's output has not been especially marked, it being only 12 per cent. upon that of the previous 12 months.

The following are the chief points in the directors' report:—

During the year 1897 there has been added to the company's mains, the equivalent of 2,562 8-candle-power lamps, making the total 21,195. The number of units supplied has been 221,507, an increase of 23,992 or 12 per cent. The total cost of coal has been diminished by 5½ per cent. 42 new consumers have been added, making the total 329.

The capital expenditure for the past year has been £5,872 11s. 4d.; 2,027 yards of main conduit pipe and cable have been laid down, making the total at present 15,298 yards. To insure the continuity of supply in the event of an accident to any one line a duplicate system of distribution has been nearly completed, a large amount of the cable laid has been for this purpose.

During the year the mains have been extended from the end of Regent Street as far as Norwich Street and Harvey Road, a sub-station having been built to supply this district. Preparations have been made to convey the mains to Madingley Road in order to supply the new Presbyterian College, now building, and the district.

The company after paying all charges, placing £400 to the reduction of preliminary expenses, and £300 to depreciation account, has a balance of £2,460 19s. 10d., which, added to £278 19s. 7d. brought forward from last year, makes £2,739 19s. 5d. An interim dividend of £953 9s. 10d. and interest on debenture and temporary overdraft £48 1s. 8d., have already been paid, leaving a net balance of £1,738 7s. 11d., out of which the directors recommend the payment of a dividend of 3½ per cent., making, with 2½ per cent. already paid, 6 per cent. for the year. This will absorb £1,445 11s. 1d., leaving a balance to carry forward of £292 16s. 10d.

The following table gives the cost per unit:—

| | 1897. | 1896. |
|---|---|---|
| Total capital expended... ... ... | £43,922 | — |
| Number of units sold ... ... ... | 221,507 | — |
| Number of lamps connected ... ... | 21,195 | — |
| Revenue from sale of current ... ... | £5,856 | — |
| Net revenue ... ... ... ... | £2,461 | — |
| Average price obtained per unit ... | 6·3d. | |

| Cost of Production. | £ | s. | d. | | Per unit. |
|---|---|---|---|---|---|
| Coal .. .. .. .. .. | 1,099 | 0 | 0 | | 1·19d. |
| Oil, waste, water, and engine room stores | 134 | 0 | 0 | | ·14d. |
| Salaries and wages at generating station | 803 | 0 | 0 | | ·87d. |
| Repairs and maintenance of buildings, engines, boilers, dynamos, &c. | 417 | 0 | 0 | (Works' cost) 2·65d. | ·45d. |
| Rent, rates and taxes .. .. .. | 339 | 0 | 0 | | ·36d. |
| Management expenses, directors' remuneration, salaries of managing engineer, secretary, clerks, &c., stationery and printing, general establishment charges, auditors, law charges and insurance | 669 | 0 | 0 | | ·72d. |
| Depreciation of buildings and plant account .. .. .. .. | — | | | | — |
| Renewal fund account .. .. .. | — | | | | — |
| Total | £3,461 | 0 | 0 | | 3·73d. |

| Revenue. | £ | s. | d. | Average price obtained per unit. |
|---|---|---|---|---|
| By sale of current .. .. .. | 5,858 | 0 | 0 | — |
| Meter rents, &c. .. .. .. .. | 293 | 0 | 0 | — |
| Other items .. .. .. .. | 473 | 0 | 0 | — |
| Total | £6,624 | 0 | 0 | — |

Total cost per unit (exclusive of depreciation and renewal accounts), 3·73d.; works' cost, 2·65d.

## The Electric Lighting Companies' Dividends.

The following are the complete dividends of electric lighting companies up to the moment of going to press:—

| London. | 1897. % | 1896. % | 1895. % | 1894. % |
|---|---|---|---|---|
| Charing Cross and Strand Electricity Supply ... ... ... | 7 | 6 | 5 | — |
| St. James' and Pall Mall ... ... | 14½ | 10½ | 7½ | 6½ |
| Westminster ... ... ... ... | 12 | 9 | 7 | 5 |
| **Provincial.** | | | | |
| Cambridge Electric Supply Company | 6 | 5 | 3½ | — |
| Newcastle-upon-Tyne Electric Supply Company ... ... ... | 7 | 5 | — | — |
| Scarborough Electricity Supply Company... ... ... ... | 5 | — | — | — |
| Yorkshire House-to-House Company | 6 | 6 | 5 | 4 |

## The St. James' and Pall Mall Electric Light Company, Limited.

The ordinary general meeting of the shareholders of this company was held on Tuesday last at the offices, Carnaby Street Central Station, Golden Square, W., Mr. Eustace J. A. Balfour in the chair.

The Chairman, in proposing the adoption of the report and accounts, said: "Gentlemen, before I ask you to pass the resolution, I will just briefly go through a few points, and I will ask any gentleman afterwards who may have any questions to ask to put them to me, and I will endeavour to answer them satisfactorily. The working of the past year, as you will have seen by the accounts, has been, on the whole, very satisfactory. At the end of the year we have 126,000 8-candle-power lamps connected, being an increase of about 18,000 for the year, and there is reason to believe that with the growing increase in popularity of electricity, both for lighting and power purposes, this rate of increase will not only be fully maintained, but largely exceeded. Recognising that such an increase will be best obtained by reducing from time to time the price to consumers, the directors have had put into force, from January 1st, a new rate, by which 6d. per unit is charged for the first £100 of the annual bill, and 4d. per unit for the rest, while all electricity for motive purposes is charged 3d. per unit. The St. James' Company now stands ahead of all other companies as regards its works' cost and total cost per unit sold, and we think this is a very creditable position for a company like this, which is by no means the biggest in the metropolis. Out of the profits of the year the directors propose to pay a dividend of 14½ per cent. We see at once that this dividend will excite a certain amount of criticism from local authorities and other consumers, and, perhaps, others interested; but, in reply to this, I want to point out that the average price of 5d. per unit, which the board will receive for the current year, is a fair and reasonable one, and considerably below the statutory price, and below the charges made by most other Metropolitan electric light companies. The ordinary, and, in fact, the total capital of the company is exceedingly small for its output, as compared with other companies, and the directors hold that the shareholders are entitled to a fair return as the result of careful expenditure and good management. Moreover, this dividend of 14½ per cent. is fictitious, for under the articles of association the founders' rights compel a division of the whole of the surplus without allowing for any reserve—a very necessary item in a business of this description. Happily for all parties an agreement with the founders—subject to your approval to-day—is practically settled, and the company will then be at liberty to provide a proper reserve fund, which will render the credit and dividends of the company more stable. I think it should be clearly understood that we have a lease of life of only 35 years from this year. The investment, therefore, is rather like a leasehold investment, in which you would not only expect a fair return for your money, but would also expect to be able to put by such a sum as at the end of those 35 years would leave you where you stood before you made the investment. It should also be borne in mind that, although we have very little in the way of precedent to go upon as to the price at which a concern of this kind would be purchased, yet what little precedent we have in the case of the County Council and the tramways is absolutely against the probability of our receiving anything at all for the goodwill of the concern; it would simply be a valuation of the buildings, plant, and machinery and property. Therefore it should be recollected that a 14½ per cent. dividend does not, and should not, represent the true earnings of the company. It appears on the face of it to be a very large figure; but if we were able, as we shall be able I hope in the future to deduct from that money to form a redemption fund, then I hope no local authority, or any of our customers will have any just grounds for complaint, and at the same time, of course, the shareholders will be benefitted to exactly the same extent as they are at present. The extension of the Carnaby Street station will shortly be completed, and the company will then have a total horse-power of over 6,000, with mains of sufficient capacity to carry the full output, and it is anticipated that with this provision, the company's works can be carried on with the existing stations for two further winter seasons. The directors attribute a large portion of the success of the company to the fact that it has been their policy to keep their resources, in the way of plant, &c., well ahead of their requirements, so that they have been able to deal with their customers promptly, and to carry out alterations in their system without interfering with the supply. Following out this policy, it has become necessary to provide at once for further extensions of the company's work, so that it may be ready before their present resources are outrun. The directors have therefore secured a valuable freehold site in every way most suitable for the most economical generation of electricity, and they are now carefully considering the best methods of dealing with this extension in the best interests of the shareholders. As the negotiations are necessarily very delicate, the directors trust that the shareholders will be satisfied with this statement, that in all future issues the policy of the directors of giving a preferential allotment to their own shareholders will be continued, and before raising any large amount of capital they will take an opportunity of putting the scheme very fully before the shareholders. I have nothing more to add, but, as I said, I shall be very happy to answer any questions that may be put to me."

Mr. Latimer Clark seconded the resolution.

Mr. Foster said he noticed that £12,000 of the proposed new shares of £5 each were to be issued to the holders of the founders' shares, but he should like to know to whom the balance of 8,000 would be allotted, and at what price? According to the articles of association, the directors were entitled to 10 per cent. on the interest paid, which, for the past year, amounted to £3,000. They had, however, only credited themselves in the accounts with £2,500. Was that to be taken as a precedent?

The Chairman replied that apart from the proposed issue to the founders in exchange for founders' shares, all issues of capital were governed by the articles of association, which provided that "subject to any direction to the contrary that might be given by the meeting that sanctions an issue of capital, all new shares shall be offered to the members in proportion (as nearly as conveniently can be), to the existing shares held by them."

Mr. Foster enquired if the privilege would be extended to new shareholders.

The Chairman said it would apply to all on the register at the time of the issue. As to the directors' fees, he said that the action of the board this year in taking less than the sum to which they were entitled, was not to be considered as a precedent.

Mr. Bowin thought the shareholders would like to know the intentions of the directors with reference to the proposal made some time ago for reducing the interest on the debenture stock of 3½ per cent.

Mr. Leaf, one of the directors, said the reason the board made the proposal referred to by Mr. Bowin, was that they thought they were paying too much. So soon, however, as they had settled matters with regard to the founders' shares and the new extension site, they hoped to be able to deal with the interest on the debenture stock.

The resolution was carried unanimously.

The retiring directors were then re-elected, as were also the auditors.

An extraordinary general meeting followed, at which, on the motion of the Chairman, seconded by Mr. Latimer Clark, the resolutions passed at a recent extraordinary general meeting, approving of an agreement with the founders' shareholders, and an increase of the capital to £300,000, were unanimously confirmed.

## Anglo-American Telegraph Company.

The ordinary general meeting of the proprietors of the above company was held on Friday last at Winchester House, Old Broad Street under the presidency of Mr. F. A. Bevan, the chairman.

Mr. P. H. Wells (the secretary) having read the advertisement convening the meeting, the report was taken as read.

The Chairman, in proposing the adoption of the report, said he had very few observations to make. As they had probably observed, the report itself contained very little, and happy was the country that had no history. However, he was glad to say that what he had to tell them was of a cheerful nature. For the first time since 1884 they were able to declare a dividend of 3 per cent. upon the ordinary stock, which meant the maximum dividend of 6 per cent. on the preferred stock. He thought that was matter of congratulation, especially when they took into account that it did not arise from any spasmodic increase of traffic, but that it was the result of a steadily-growing traffic, which had been increasing during the last four or five years. He would give them the figures as to the share that came to the Anglo-American Company out of the pooled traffic during the last four years. Four years ago the figure stood at £284,000; the next year it was £307,000; the next £326,000, while in the year they were now reviewing, it was £354,000, which gave an increase of £70,000 in four years, while during the same period the expenses had remained practically at the same figure, viz., £111,000, so that the shareholders had reaped the full benefit of the increase of traffic. But notwithstanding that large increase of traffic, the directors would not have been able to pay a 3 per cent. dividend, unless they had been helped by what he might call a considerable amount, from the work of their repairing ship, *Minia*. In the first half of the year, the *Minia* earned for them £8,455, and in the last half, £2,820, making altogether £11,275, and he would like to impress upon the shareholders that but for that windfall, as he might call it—for they could not calculate that they would always make that amount out of their repairing ship—they would not have been able to pay the dividend of 3 per cent. The shareholders would be glad to know that the current year had opened very well, and that the receipts for January were a record over every other January that they had ever had, and therefore they began this year with things looking very well. One, of course, could not predict that that increase would continue, but they might fairly hope that this current half-year would be a good one. He would now compare the figures of the last half-year with those of the corresponding six months in 1896. For the half-year under review, their total net increase of receipts was £9,258 7s. 10d., and the increase of expenses was only £371 16s. 8d.; but he might add that the increase in the expense of repairs of cables amounted to £469 9s. 3d., and therefore, but for that increase, there would have been an actual decrease in the expenses. They brought forward to the current half-year £6,704 0s. 8d. more than in the corresponding half of 1896, so that they had available for dividend £15,590 more than at that period. The dividend in February, 1896, was at the rate of 29s. per cent.; what they now proposed was at the rate of 33s. 6d. per cent. That meant an increase of £15,750, rather more than the figure he had given above, so that they carried over £159 8s. 2d. less than they did in the corresponding period of last year. He thought the shareholders would consider those statements very satisfactory. Coming to the renewal fund, he would remind them that the directors attached very great importance to that fund, which, in their opinion, was not as yet at all equal to what it should be, taking into consideration the fact that their cables were getting older each year, and that the two oldest cables were 24 and 23 years old, so that if they had to replace one of those cables they would have at once to spend a very large portion of the renewal fund. During the past year they had only added £33,000 to the fund, for though, according to their usual practice, they had taken £24,000 from the revenue, and the interest amounted to another £20,000, they had had to spend £11,000 in repairing their 1880 cable, so that the net result was that they had only added some £33,000 to the fund. It now amounted nominally to £760,000 odd, which was only about 10 per cent. of the capital, and he ventured to express the hope that no shareholder would suggest to the directors that they should in any way cease from maintaining that reserve fund, but that the shareholders would back the directors in continuing to add to it. Regarding the investment of the fund, a portion of it constituted their working capital, and some was invested in their leasehold premises at the end of Throgmorton Street. They had over £600,000 invested, but the market value would be considerably in excess of that sum. But looking at all the circumstances; to the age of their cables, and that they had no other fund to apply to, he trusted they would agree that the fund was by no means too large, and his (the chairman's) own opinion was that it was not nearly large enough. He was glad to be able to say that their cables were all in good working order, except a short cable on the other side, which broke down since the report was printed. But that was really a matter of no moment, and when the proper time came it could be mended without difficulty. He was also able to say that their traffic had never been carried better than it was now, and that the staff had never been more efficient. Since he last addressed them, he had had an opportunity of visiting the station at Valencia, and was very much pleased with all he saw there. One of the oldest men in their employ—Mr. Graves, was superintendent there, and a most valuable man he was. He had got together a staff of very efficient workers, and all that he saw there of the work gave him great satisfaction. It was in great part owing to the efficiency of their staff that they were able to maintain the traffic, and therefore increase the dividend.

Sir Gerald Fitzgerald, K.C.M.G., seconded the motion.

Replying to a short discussion, the Chairman said the policy of the board was to carry on the company, and do what was best for the good of the shareholders generally, irrespective of what were called the rights of preferred or deferred shareholders. He had all along been of opinion that it was a mistake to have split up the stock, but at the time it was forced upon the directors by the shareholders, so that the board were not responsible for it.

The report was then adopted.

Sir Gerald Fitzgerald and Mr. C. Burt, the retiring directors, were re-elected, and the auditors were also re-elected for the current year.

## Newcastle-upon-Tyne Electric Supply Company, Limited.

The directors' report to the tenth general meeting of the shareholders states that the demand for electricity continues to improve satisfactorily, the units sold having been 660,906, against 535,953 last year. The total profit for the year, including the balance brought forward from last year, represents a sum of £5,059 10s. 3d. Out of this the directors recommend a dividend at the rate of 7 per cent. per annum for the year, on account of which an interim dividend at the rate of 5 per cent. per annum was paid on July 15th last. The total dividend will absorb £3,144 15s. 6d., leaving a balance of £1,914 14s. 9d., which the directors have dealt with as follows:—

| | £ | s. | d. |
|---|---|---|---|
| (*a*) In writing off the preliminary expenses in connection with the recent increase of capital sanctioned last year ... ... ... ... ... ... | 62 | 15 | 0 |
| (*b*) In increasing the reserve and depreciation account to £2,200 by a further sum of ... ... ... | 1,200 | 0 | 0 |
| (*c*) In carrying forward to next year the balance of ... | 651 | 19 | 9 |
| | £1,914 | 14 | 9 |

In order to meet the developments rendered necessary by the constantly increasing demand for electrical energy, it is intended to issue, at once, part of the new capital sanctioned at the last general meeting. The directors recommend that the shares be offered to existing shareholders *pro rata* at a premium of £1 10s. per share: the amount of this premium to be added to the fund for depreciation and reserve. The directors feel themselves greatly indebted to the Durham College of Science for assistance in scientific questions on various occasions in their past history, and they desire to receive authority from the shareholders to make an annual subscription of not exceeding £50 to that institution.

## The Cuba Submarine Telegraph Company, Limited.

The report of the directors for the half-year ending December 31st, 1897, to be presented at the fifty-third ordinary general meeting of shareholders, to be held on February 16th, 1898, states that the gross receipts amount to £19,167 7s. 9d., and the gross expenditure to £6,602 10s. 9d., leaving a sum of £12,564 17s., which, added to the balance of £3,317 9s. brought from the last account, leaves £15,882 6s. at the credit of revenue account. The sum of £4,827 17s. 1d. has been added to the reserve fund, together with £1,274 7s. profit on investments realised, while £17,830 4s. 10d. part cost of the new Manzanillo-Santiago cable, and £271 19s. 3d. for repairs have been charged to this account, leaving a balance of £106,000 to its credit. The dividend on the preference shares will absorb £3,000 and leave £8,054 8s. 11d., out of which the directors recommend the payment of a dividend on the ordinary shares at the rate of 6 per cent. per annum, free of income-tax, the balance, £3,254 8s. 11d., being carried forward to the current half-year. The traffic receipts show a decrease of £9,662 17s. 9d. as compared with the corresponding period of last year, due principally to the loss of the French company's traffic, which is now conveyed by that company's new line between Hayti and New York, as explained in the report of December 31st, 1896. The directors much regret that, owing to the falling off in the receipts, a reduction in the rate of dividend on the ordinary shares has become necessary. In consequence of the establishment of the new line between Bermuda and Jamaica—subsidised by the British Government on the basis of a charge of 3s. per word between the United Kingdom and Jamaica—the Cuba Company have been

compelled to accept reduced rates which will result in a considerable loss of income. The new cable between Manzanillo and Santiago, referred to in last report, is now being laid, and on the completion of this work the vessel will proceed to the repair of the Cienfuegos-Santiago 1881 cable. The other sections of the company's cables have continued in good working order throughout the half-year, with the exception of some slight repairs to the harbour lengths at Santiago.

## United Ordnance and Engineering Company, Limited.

The prospectus of the above company (with which is incorporated the business of Easton, Anderson & Goolden, Limited), has been before the public this week. The authorised capital is as follows: £275,000 in £1 5½ per cent. cumulative preference shares; £275,000 in £1 ordinary shares; £250,000 4½ per cent. first mortgage debenture stock. The whole of this £800,000 has been offered for subscription. The company is formed:—

1. To manufacture and sell guns, gun carriages, ammunition, and war material, and to carry on business as electrical, hydraulic, mining, and general engineers.

2. To acquire a licence dated November 19th, 1897, granted by Messrs. Schneider & Co., of Creusot and Havre, the celebrated manufacturers of guns and war material, to manufacture and sell the Schneider-Canet artillery.

3. To acquire and take over as a going concern the undertaking of Easton, Anderson & Goolden, Limited, the well-known engineers, of Erith and London.

The last item (3) is arranged in order to lessen the delay inseparable from the establishment of new works. Messrs. Easton, Anderson and Goolden's premises and plant are valued by Messrs. Fuller, Horsey, Sons & Cassell in a report dated April, last year, as follows:—

Freehold engineering works, with fixed and loose plant (exclusive of goodwill), £202,257.

Messrs. W. P. Peat & Co., value the stocks, stores, and assets of the undertaking in hand on June 30th, 1897 (exclusive of goodwill), £154,955, making the total £357,212, which sum is subject to liabilities at June, 1897, amounting to £35,956.

The business has been carried on from June 30th, 1897, down to December 31st, 1897, from which date it is to be taken over by the company, on the account and at the risk of Mr. Ernest Terah Hooley, who will indemnify the company against any risk of loss arising from the recent engineers' strike and lock-out, or otherwise during that period. The agreement for the purchase of this business provides that Messrs. Wilson & Baynes, directors of Easton, Anderson and Goolden, Limited, shall be appointed managing directors of the company for a period of five years. In addition to the manufacture of ordnance and war material, the company will continue, develop and extend the general engineering business of Easton, Anderson and Goolden, Limited, and in connection therewith special attention will be devoted to electrical traction and electrical transmission of power, in both of which branches there will undoubtedly be great developments, both at home and abroad, in the immediate future. Several important schemes have been submitted to Easton, Anderson and Goolden, Limited, and will be carefully examined by the directors of this company.

The directors of the company are Admiral Sir H. F. Nicholson, K.C.B., H. McCalmont, M.P., F. Elgar, LL.D., F.R.S., Charles Cammell, Colonel Paget Mosley, T. Perceval Wilson (chairman of Easton, Anderson & Goolden, Limited), a managing director: H. K. Baynes (director of Easton, Anderson & Goolden), a managing director. The secretary is Mr. W. E. Davies, and the registered office is at Broad Sanctuary Chambers, Westminster, S.W. The list closed on Wednesday, 9th inst.

## Liverpool Overhead Railway Company.

The ordinary half-yearly general meeting of the Liverpool Overhead Railway Company was held on Tuesday, 8th inst., at the Law Association Rooms, Cook Street, Liverpool. Sir Wm. Forwood, chairman of the company, presided.

The report showed that the gross revenue receipts for the half-year amounted to £37,583, and the working expenses to £24,240, after deducting the interest on mortgage debentures; and adding the balance of £3,810 brought forward from the previous half-year, there was £13,753 available for dividend. Out of this it was proposed to pay dividends of 5 per cent. on the preference shares, and 3½ per cent. on the ordinary shares, leaving £2,878 to be carried forward to next half-year.

The Chairman, in moving the adoption of the report and accounts, said he had pleasure in being able to congratulate the shareholders upon the progress and position of the company. In the corresponding half of last year they paid a dividend of 3 per cent. per annum, and last half-year 3 per cent., making 3½ for the year with the dividend recommended that day. During the year they had paid to the Liverpool Tramway Company £2,000, in conformity with the terms of their agreement with them. That agreement had now come to an end, having terminated on the 10th of last month. There had been an increase in the traffic during the past six months of 545,000 passengers, or, for the year, of 1,078,000. Part of that increase was due to the opening of the Dingle Station, at the south end. They carried last year 8,736,000 passengers, the number they carried in the first completed year after the opening of the railway being 5,400,000, so that they had increased by 3,200,000 passengers—a rate of progress in five years which he had no doubt they would consider eminently satisfactory. They had run during the half-year 371,000 miles, against only 320,000 in the corresponding half of last year. They were keeping the expenditure carefully in hand. Their ratio of revenue to expenditure worked out at 64·54 per cent. That might strike them as being rather high, but when they eliminated the amount carried to renewal and contingent funds, and the amount paid to the Tramway Company, neither of which were fair charges upon the traffic, their traffic expenses were reduced to 56 per cent. of the revenue, which he thought was a very reasonable and moderate figure. The expenditure per train mile during the half-year was 15·65d., against 15·67d. in corresponding half of last year. The revenue per train mile was equal to 24·25d., against 23·79d., which was a slight increase. The locomotive expenditure was 3·71d., against 3·68d. per train mile—practically the same. They endeavoured to maintain the efficiency of the line in every way, and it was to-day in better condition from one end to the other than five years ago, when it was opened to the public. The electrical equipment was also maintained in the highest state of efficiency, and though it but cost a little more to revenue, they felt they would be recouped fully by doing so. They had now £10,700 to the credit of the renewal and contingent funds. The traffic upon the south extension was showing a very satisfactory growth. The complaints which had formerly been made as to the lighting of the carriages had received attention, and during the past fortnight the booster they had ordered had come to hand, and would be placed in position at the south end, so that, he was glad to say, the light was now as steady as possible. Their experience of the booster would make them get one for the north end also. All the carriages had now been heated with electric heaters, and were now very comfortable. When it was borne in mind that they only charged 3d. for a journey that would cost 13d. on the London and North-Western Railway, it would be seen that they were doing a great public service.

Mr. Richard Hobson seconded the motion.

The Chairman, replying to Mr. Menzies, who said he did not think a dividend of 3¼ per cent. per annum, was a sufficient rate of progress, said they were paying the dividend this year entirely out of profits. Of course a railway company could not be measured by any industrial concern; it was not expected to pay at any time large dividends. He thought the growth of the line had been very satisfactory. If they had had no payment to make to the tramway company, the dividend would have been perhaps 3¾ per cent. He had no doubt the line would pay a larger dividend in the future.

The motion was then carried unanimously, and it was also agreed to pay the dividends referred to above.

Messrs. Edward Lawrence and G. H. Robertson were re-elected directors.

The Chairman, replying to a vote of thanks to the directors for their services, said he would like to remark upon how much they valued the services of their very excellent engineer and manager, Mr. Cottrell. They were largely indebted to him for his zeal and watchfulness. Very few men in this country had his technical knowledge of electricity, and he had also great tact and organisation in dealing with working men, which were very valuable qualities.

The proceedings then terminated.

## The National Telephone Company, Limited.

The report of the directors for the half-year ending December 31st, 1897, to be presented to the shareholders at the twenty-first ordinary general meeting of the company, to be held at the City Terminus Hotel, Cannon Street, London, on Thursday, February 17th, 1898, at 1 o'clock p.m., reads as follows:—

"The income accrued in respect of the business of the half-year amounts to £507,602 17s. 3d., as compared with £439,978 2s. 4d. for the corresponding period of 1896, being an increase of £67,624 14s. 11d. The working expenses for the half-year amount to £283,085 12s. 11d., as compared with £245,278 13s. 9d. for the corresponding period of 1896, being an increase of £37,806 19s. 2d. The net result for the half-year (after deducting the Post Office royalties amounting to £46,059 16s. 8d.) is a profit balance of £178,457 7s. 8d., as compared with £154,982 8s. 4d. for the corresponding period of 1896, being an increase of £23,474 19s. 4d. The rentals carried forward for unexpired terms of running contracts amount to £473,586 17s. 10d., as compared with £414,714 9s. 8d. at the corresponding period of 1896, or an increase of £58,872 8s. 2d.

"Out of the available balance of £156,435 8s. 5d. shown by the net revenue account (No. 3) the board will recommend the payment of a dividend at the rate or 6 per cent. per annum, less income-tax, on the first and second preference shares, 5 per cent. per annum, less income-tax, on the third preference shares, and 6 per cent. per annum, free of income-tax, on the ordinary shares. The board also propose to transfer £40,000 to the reserve fund, and to carry forward the balance of £10,034 3s. 5d.

"Capital Expenditure.—The sum of £267,375 1s. 3d. has been expended on capital account during the half-year, partly in the erection of 5,633 additional exchange and private lines and partly in the construction of underground lines in substitution for overhead wires in several important places. Notably in Manchester, the corporation of that great centre of industry were the first to realise the many advantages to the commercial community to be secured by the concession, upon reasonable terms, of the necessary powers, and as a consequence the entire system of underground mains in that area has been completed. The financial burden cast upon the company is considerable, but the board have faced it in the confident belief that greatly increased efficiency will lead to a corresponding extension of the use of the telephone. Similar concessions having been made by the authorities of Belfast, Birmingham, Blackburn, Bradford, Bristol, Dublin, Dundee, Leeds, Liverpool, Nottingham,

Portsmouth, Sheffield, and other leading cities and towns, the underground works in these places are being proceeded with as rapidly as possible. In the interest of the more perfect intercommunication between subscribers in the several localities, which must immediately result from the change of system, it is to be hoped that other important places will speedily follow the enlightened lead of the great telephonic centres above enumerated.

"It having been determined that the valuable services of Mr. Alderman Joseph Thompson could be more advantageously absorbed in a more specific attention to the affairs of the company in Manchester, where he is so generally known and appreciated, he was good enough to undertake those duties, and a vacancy in the board resulted. This has been filled by the election of the Rt. Hon. Sir Henry Hartley Fowler, G.C.S.I., M.P., whose residence in and long connection with the very important telephone area of which Wolverhampton is the centre, appeared to justify his being invited to join the board in the interest alike of the company and the public."

## Westminster Electric Supply Corporation, Limited.

The report of the directors states that the business of the corporation continues to make satisfactory progress. The supply of current which, on December 31st, 1896, was provided for the equivalent of 249,318 lamps of 8-C.P., had increased by December 31st, 1897, to the equivalent of 290,561, and at the present time there are on circuit the equivalent of 292,883 lamps of 8-C.P., and applications have been received for a further 10,886. The length of roadway in which mains have been laid now exceeds 44 miles, making about 180 miles of ways, into which upwards of 152 miles of copper (strip and cable) have been drawn.

The extension of the central stations, rendered necessary in consequence of the increase in the business of the Corporation, as reported at the last general meeting, has been proceeding during the year, and the board are glad to be able to report that the additional buildings and plant are now nearly completed. The plant and machinery have been working satisfactorily throughout the year, and have been fully maintained from revenue, and the directors consider that, although the economical working of the stations has been greatly affected by building operations, it is satisfactory to note that there is no increase in the cost per unit generated.

As stated in their last report, the board had approached the holders of the founders' shares, and had agreed with them a scheme for cancelling the founders' shares, but on further consideration it was found that difficulties might arise thereafter, and an amended scheme was proposed, in accordance with resolutions passed at special meetings of the shareholders called for that purpose. Your directors have pleasure in stating that, owing to the way in which they were met by the holders of the founders' shares, those shares have ceased to exist, and all the shareholders are now on the same footing.

The net revenue of the year amounts to £49,461 3s. 10d. An interim dividend, at the rate of 8 per cent. per annum, for the half-year ending June 30th, 1897, has been distributed. The balance to the credit of the account is £34,013 17s. 5d.; the board, therefore, recommend the payment of a dividend at the rate of 16 per cent. per annum, less income-tax, for the past half-year, making 12 per cent. for the year ending December 31st last, carrying forward a balance of £3,119 4s. 1d.

The directors having considered the question of provision of future capital, gave notice to pay off the present mortgage debentures bearing interest at the rate of 5 per cent. and 4½ per cent. per annum on March 1st next, and have created new first mortgage debentures of £250,000, bearing interest at the rate of 3½ per cent. per annum. Of this amount £200,000 has been issued, and after providing for repayment of the old debentures, the balance will be expended in further plant and machinery, and the extension of existing stations. The board much regret that owing to the issue having been subscribed four times, they were unable to make any allotment to a large number of applicants.

## Portrush and Giant's Causeway Tramway Company.

The twenty-second ordinary meeting of this company was held on 1st inst. at Portrush. Dr. Anthony Traill presided. After the routine business the directors' report was submitted and adopted. It stated: "Your directors have to report a falling off in the receipts during the past year, as compared with those of the year of 1896. In the passenger traffic there has been a decrease in numbers, the total number being 79,015. This falling off has arisen from the interference of the Board of Trade with our electric traffic, and from the unusual wetness of the summer season."

## The Dublin United Tramways Company (1896), Limited.

The report of the directors submitted to the meeting held at the Imperial Hotel, Lower Sackville Street, Dublin. The directors submit the accounts for the half-year ended December 31st, 1897. The receipts amount to £19,250 1s. 6d. from the Dublin United Tramways Company, and £3,581 15s. from the Dublin Southern District Tramways Company, making, with the balance brought from last half-year, and the profit on Bank of Ireland Stock, sold, £23,409 7s. 5d. at credit of revenue account. Deducting mortgage debenture interest, £1,429 9s. 2d., and directors' fees, £450, a sum of £21,529 18s. 3d. will remain available for division. Out of this sum the directors have declared a divided at the rate of 6 per cent. per annum on the preference shares, and at the rate of 4 per cent. per annum on the ordinary shares, leaving a balance of £922 18s. 6d. The section of the Clontarf line from Dollymount to Annesley Bridge has been worked by electricity since November 11th last, with very satisfactory results, and it is expected that within the next few months the electric cars will be running to Nelson's Pillar from Annesley Bridge on the north side, and from Haddington Road (Dalkey line) on the south. The new line connecting Rathmines with Ball's Bringe *vid* the Appian Way and Pembroke Road, is being constructed. A Bill to permit of increased speed on the Haddington Road and Dalkey line is being promoted by the Dublin Southern District Company, and the directors expect that it will successfully pass through Parliament.

## Waterloo and City Railway Company.

Mr. Wyndham S. Portal presided yesterday over the eighth half-yearly meeting of the shareholders of this company held at Waterloo, and in moving the adoption of the report said that the whole of the share capital, £540,000, had now been received, and the total outlay, up to December 31st last, had amounted to £473,776, which included £25,000 for interest paid to the shareholders during the construction of the line. The directors hoped to be able to arrange with the London and South-Western Railway Company for bringing the line into use by the middle or end of next month.

Col. Campbell seconded the motion, and the report was adopted.

**The City of London Electric Lighting Company, Limited.**—Gross revenue return, quarter ended December 31st, 1897. Gross revenue from sale of current for public lighting (after deduction of allowances), quarter ended December 31st, £3,119; corresponding quarter last year, £2,970. Gross revenue from sale of current for private lighting (after deduction of allowances), &c., quarter ended December 31st, £59,796; corresponding quarter last year, £53,399. Gross revenue from other sources (estimated), quarter ended December 31st, £2,000; corresponding quarter last year, £1,000; total, quarter ended December 31st, £64,915; corresponding quarter last year, £57,369; increase £7,546. Equivalent of 8-C.P. lamps connected on December 31st, 1897, 296,012; increase during quarter, 17,850. Equivalent of 8-C.P. lamps connected on December 31st, 1896, 247,785; increase during corresponding quarter last year, 19,045.

**British Electric Traction Company.**—The Electric and General Investment Company have offered for subscription a first issue by the British Electric Traction Company, Limited, of 10,000 6 per cent. cumulative preference shares, of £10 each, at £12 10s. per share. The share capital of the latter company is £600,000, in equal proportions of 6 per cent. cumulative preference and ordinary £10 shares, and the undertaking was, the prospectus states, formed in November, 1896, to acquire the business of the British Electric Traction (Pioneer) Company, and to develop electric traction in the United Kingdom and elsewhere. It is pointed out that all the ordinary shares (30,000) have been subscribed and paid up in full, and that applications from holders of these for the present issue will be preferentially considered. The subscription list opened on Tuesday, and was to close yesterday.

**The Edison and Swan United Electric Light Company, Limited.**—The directors have resolved that a payment on account of the dividend of the current year be made at the rate of 5 per cent. per annum, less income-tax, on the "A" shares of the company, in respect of the half-year ended December 31st, 1897. This will work out at 1s. 6d. per share on the partly paid £5 shares £3 paid, and 2s. 6d. per share on the fully-paid £5 shares, less income-tax. The payment will be made upon the register as it stands this day, and the dividend warrants will be issued on the 24th inst.

**W. T. Henley's Telegraph Works Company, Limited.**—The directors have resolved to recommend a dividend at the rate of 12 per cent. per annum on the ordinary shares, including the interim dividend of 3 per cent. paid in September.

**Metropolitan Electric Supply Company, Limited.**—A meeting of the holders of founders' shares of this company was held at Winchester House on Tuesday, but our representative was informed that the meeting was private.

**Stock Exchange Notices.**—The committee have ordered to be quoted in the Official List:—Direct West India Cable Company, Limited—£120,000 4½ per cent. registered debentures, Nos. 1 to 1,200.

**Telegraph Construction and Maintenance.**—The directors announce a further dividend of 10 per cent., making 15 per per cent. for the year 1897.

## TRAFFIC RECEIPTS

**The City and South London Railway Company.** The receipts for the week ending February 6th, 1898, were £1,063; week ending February 7th, 1897, £1,123; decrease £60; total receipts for half-year, 1898, £6,456; corresponding period, 1897, £6,611; decrease, £155.

**The Liverpool Overhead Railway Company.** The receipts for the week ending February 6th, 1898, amounted to £1,283; corresponding week last year, £1,241; increase, £42.

**The Western and Brazilian Telegraph Company, Limited.** The receipts for the week ending February 4th, 1898, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £2,856.

## SHARE LIST OF ELECTRICAL COMPANIES.

### TELEGRAPH AND TELEPHONE COMPANIES.

| Present Issue. | NAME. | Stock or Share. ‡ | Dividends for the last three years. 1895. | 1896. | 1897. | Closing Quotation, Feb. 2nd. | Closing Quotation, Feb. 9th. | Business done during week ended Feb. 9th, 1898. Highest. | Lowest. |
|---|---|---|---|---|---|---|---|---|---|
| 137,400£ | African Direct Teleg., Ltd., 4 % Deb. | 100 | 4 % | ... | ... | 100 104 | 100 —104 | ... | ... |
| 25,000 | Amazon Telegraph, Limited, shares... | 10 | ... | ... | ... | 6 — 7 | 6 — 7 | ... | ... |
| 125,000 | Do. do. 5% Debs. Red. | 100 | ... | ... | ... | 93 — 96 | 93 — 96 | ... | ... |
| 923,960£ | Anglo-American Teleg., Ltd. | Stock | £2 9s. | £2 13s. | 3 % | 62 — 64 | 62 — 64 | 63⅝ | 63½ |
| 3,038,020£ | Do. do. 6 % Pref. | Stock | £4 18s. | £5 6s. | 6 % | 112½ - 113½ | 113 — 114 | 113¾ | 112⅝ |
| 3,038,020£ | Do. do. Defd. | Stock | ... | ... | ... | 13¼ — 13¾ | 13¼ — 13¾ | 13⅞ | 13¼ |
| 130,000 | Brazilian Submarine Teleg., Ltd. | 10 | 7 % | ... | ... | 16¾ — 17¼ | 16¾ — 17¼ | 17 | 16¹⁵⁄₁₆ |
| 75,000£ | Do. do. 5 %, Debs., 2nd series, 1926 | 100 | 5 % | ... | ... | 112 —116 | 112 —116 | ... | ... |
| 44,000 | Chili Telep., Ltd., Nos. 1 to 44,000 | 5 | 4 % | 4 % | ... | 3 — 3½ | 3 — 3½ | ... | ... |
| 10,000,000$ | Commercial Cable Co. | $100 | 7 % | 7 % | ... | 187 —192 | 187 —192 | 197 | ... |
| 653,586£ | Do. Do. Sterling 500 year 4% Deb. Stock Red. | Stock | ... | ... | ... | 106 —108 | 106 —108 | 107½ | 106½ |
| 224,850 | Consolidated Telep. Const. and Main., Ltd. | 10/- | 1½% | 2 % | ... | ⅛ — ⅛ | ⅛ — ⅛ | ... | ... |
| 16,000 | Cuba Teleg., Ltd. | 10 | 8 % | 8 % | ... | 8 — 9 | 8 — 9 | 8⅝ | ... |
| 6,000 | Do. 10 % Pref. | 10 | 10 % | 10 % | ... | 18 — 19 | 17½ - 18½ | ... | ... |
| 12,931 | Direct Spanish Teleg., Ltd. | 5 | 4 % | 4 % | ... | 4 — 5 | 4 — 5 | ... | ... |
| 6,000 | Do. do. 10 % Cum. Pref. | 5 | 10 % | 10 % | ... | 10 — 11 | 10 — 11 | ... | ... |
| 30,000£ | Do. do. 4½ % Debs. Nos. 1 to 6,000 | 50 | 4½% | 4½% | ... | 103 - 106% | 103 —106% | ... | ... |
| 60,710 | Direct United States Cable, Ltd. | 20 | 2½% | 2½% | ... | 10½ — 11 | 10⅜ — 11¼ | 11¼ | 10⅞ |
| 400,000 | Eastern Teleg., Ltd., Nos. 1 to 400,000 | 10 | 6½% | 6½% | ... | 18 — 18½ | 18 — 18½ | 18⅜ | 18¹⁵⁄₁₆ |
| 70,000 | Do. 6 % Cum. Pref. | 10 | 6 | 6% | ... | 19 — 20 | 19 — 20 | 19¹⁄₁₆ | 19 |
| 89,900£ | Do. 5 % Debs., repay. August, 1899 | 100 | 5 % | 5% | ... | 100 —103 xd | 100 —103 | ... | ... |
| 1,302,615£ | Do. 4 % Mort. Deb. Stock Red. | Stock | 4 % | 4% | ... | 131 —134 | 131 —134 | 133¼ | 131¼ |
| 250,000 | Eastern Extension, Australasia and China Teleg., Ltd. | 10 | 7 % | 7¾ | ... | 18¾ — 19¼ | 18¾ - 19¼ | 19 | 18¾ |
| 25,200£ | Do. 5 % (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326 | 100 | 5 % | 5% | ... | 99 - 103 | 99 —103 | ... | ... |
| 100,500£ | Do. do. Bearer, 1,050—3,975 and 4,327—6,400 | 100 | 5 % | 5% | ... | 100 - 103 | 100 —103 | ... | ... |
| 320,000£ | Do. 4 % Deb. Stock | Stock | 4 % | 4% | ... | 130 —133 xd | 130 —133 | ... | ... |
| 51,100£ | Eastern and South African Teleg., Ltd., 5 % Mort. Deb. 1900 redeem. ann. drgs., Reg. Nos. 1 to 2,343 | 100 | 5 % | 5% | ... | 99 - 103 | 99 —103 | 101⅜ | ... |
| 69,200£ | Do. do. do. to bearer, 2,344 to 5,500 | 100 | 5 % | 5% | ... | 100 —103 | 100 —103 | ... | ... |
| 300,000£ | Do. 4 % Mort. Debs. Nos. 1 to 3,000, red. 1909 | 100 | 4 % | 4% | ... | 102 —105 xd | 102 —105 | ... | ... |
| 200,000£ | Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1 to 8,000 | 25 | 4 % | 4% | ... | 108 —111 % | 108 —111% | 109 | 108½ |
| 180,227 | Globe Telegraph and Trust, Ltd. | 10 | 4½% | 4½% | ... | 12 — 12½xd | 12 — 12½ | 12⅛ | 12⅛ |
| 180,042 | Do. do. 6 % Pref. | 10 | 6 % | 6% | ... | 17¾ — 18¼xd | 17¾ - 18¼ | 18³⁄₁₆ | 18 |
| 150,000 | Great Northern Teleg. Company of Copenhagen | 10 | 10 % | 10% | ... | 27 — 28 | 27 — 28 | ... | ... |
| 160,000£ | Do. do. do. 5 % Debs. | 100 | 5 % | 5% | ... | 101 —104 | 101 —104 | ... | ... |
| 17,000 | Indo-European Teleg., Ltd. | 25 | 10 % | 10% | ... | 52 — 55 | 52 — 55 | ... | ... |
| 100,000£ | London Platino-Brazilian Teleg., Ltd. 6 % Debs. | 100 | 6 % | 6% | ... | 108 —111 | 108 - 111 | ... | ... |
| 28,000 | Montevideo Telephone 6% Pref., Nos. 1 to 28,000 | 5 | 4 % | ... | ... | 2 — 2⅛ | 2 — 2⅛ | ... | ... |
| 484,597 | National Teleph., Ltd., 1 to 484,597 | 5 | 5½% | 5½% | 6 % | 6¾ — 7 | 6¾ - 7 | 7 | 6⅞ |
| 15,000 | Do. 6 % Cum. 1st Pref. | 10 | 6 % | 6 % | 6 % | 15 — 17 | 15 — 17 | ... | ... |
| 15,000 | Do. 6 % Cum. 2nd Pref. | 10 | 6 % | 6 % | 6 % | 14 — 16 | 14 — 16 | ... | ... |
| 119,234 | Do. 5 % Non-cum. 3rd Pref., 1 to 119,234 | 5 | 5 % | 5 % | 5 % | 6 — 6½ | 6 — 6½ | 6⅝ | 6³⁄₁₆ |
| 130,766 | Do. do. Nos. 119,235 to 250,000, £5 paid | 5 | ... | ... | 5 % | 6 — 6½ | 6 — 6½ | ... | ... |
| 329,471£ | Do. 3½ % Deb. Stock Red. | Stock | 3½% | 3½% | 3½% | 104 —109 | 104 —109 | 106 | 104¾ |
| 171,504 | Oriental Teleph. & Elec., Ltd., Nos. 1 to 171,504, fully paid | 1 | 5 % | 5 % | ... | ⅝ — ¾ | ⅝ — ¾ | ... | ... |
| 100,000£ | Pacific and European Tel., Ltd., 4 % Guar. Debs, 1 to 1,000 | 100 | 4 % | 4 % | ... | 105 —108 | 105 —108 | ... | ... |
| 11,839 | Reuter's Ltd. | 8 | 5 % | 5 % | ... | 8 — 9 | 8 — 9 | 8 | ... |
| 3,381 | Submarine Cables Trust | Cert. | ... | ... | ... | 140 — 145 | 140 - 145 | 142 | ... |
| 58,000 | United River Plate Teleph., Ltd. | 5 | 4 % | ... | ... | 4 — 4½ | 4 — 4½ | ... | ... |
| 146,733£ | Do. do. 5 % Debs. | Stock | 5 % | ... | ... | 101 —106 | 101 —106 | ... | ... |
| 15,609 | West African Teleg., Ltd., 7,501 to 23,109 | 10 | 4 % | nil | ... | 4 — 5 | 4 — 5 | ... | ... |
| 213,400£ | Do. do. do. 5 % Debs. | 100 | 5 % | 5% | ... | 103 - 106 | 103 - 106 | ... | ... |
| 64,268 | Western and Brazilian Teleg., Ltd. | 15 | 3 % | 2 % | ... | 10½ - 11 | 10½ - 11 | 10⅝ | 10⅜ |
| 33,129 | Do. do. do. 5 % Pref. Ord. | 7½ | 5 % | 5 % | ... | 7¼ — 8 | 7½ - 8 | 7⅝ | 7⅜ |
| 33,129 | Do. do. do. Def. Ord. | 7½ | 1 % | ... | ... | 3½ — 4 | 3½ — 4 | 3⅝ | 3⅜ |
| 382,230 | Do. do. do. 4 % Deb. Stock Red. | Stock | ... | ... | ... | 105 —107 | 105 —107 | ... | ... |
| 88,321 | West India and Panama Teleg., Ltd. | 10 | ⅛% | 1 % | ... | ⅛ — ¾ | ⅛ — ¾ | 1¹⁄₁₆ | ... |
| 34,563 | Do. do. do. 6 % Cum. 1st Pref. | 10 | 6 % | 6 % | ... | 7½ — 8½ | 7½ — 8½ | 8½ | 7¹³⁄₁₆ |
| 4,669 | Do. do. do. 6 % Cum. 2nd Pref. | 10 | 6 % | 6 % | ... | 5 — 7 | 5 — 7 | ... | ... |
| 80,000£ | Do. do. 5 % Debs. No. 1 to 1,600 | 100 | 5 % | 5 % | ... | 105 - 108 | 105 - 108 | ... | ... |
| 1,163,000$ | Western Union of U. S. Teleg., 7 % 1st Mort. Bonds | $1000 | 7 % | 7% | ... | 105 —110 | 105 —110 | ... | ... |
| 160,100£ | Do. do. 6 % Ster. Bonds. | 100 | 6 % | 6% | ... | 100 —105 | 100 —105 | ... | ... |

### ELECTRICITY SUPPLY COMPANIES.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 30,000 | Charing Cross and Strand Electy. Supply | 5 | 5 % | 6 % | 7 % | 14 — 15 | 14 — 15 | 14⅝ | 14 |
| 20,000 | Do. do. do. 4½ % Cum. Pref. | 5 | ... | ... | ... | 6¼ — 6⅜ | 6¼ — 6⅜ | 6⅜ | ... |
| 26,000 | *Chelsea Electricity Supply, Ltd., Ord., Nos. 1 to 10,277 | 5 | 5 % | 5 % | ... | 11½ — 11⅝ | 11½ — 11⅝ | 11¹³⁄₁₆ | 11½ |
| 60,000 | Do. do. do. 4½ % Deb. Stock Red. | Stock | 4½% | 4½% | ... | 112 —114 | 112 —114 | ... | ... |
| 40,000 | City of London Elec. Lightg. Co., Ltd., Ord. 40,001—80,000 | 10 | 5 % | 7 % | ... | 29½ - 30½ | 28½ — 29½ | 29½ | 28⅜ |
| 10,000 | Do. do. Prov. Certs. | 5 | ... | ... | ... | 29 — 30 | 27½ — 28½ | 28½ | 27½ |
| 40,000 | Do. do. 6 % Cum. Pref., 1 to 40,000 | 10 | 6 % | 6 % | ... | 17½ — 18½ | 17½ - 18½ | 18¹⁄₁₆ | 17⅞ |
| 400,000 | Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid | ... | 5 % | 5 % | ... | 129 —134 | 129 —134 | 132½ | ... |
| 30,000 | County of Lond. & Brush Prov. E. Ltg. Ltd., Ord. 1—30,000 | 10 | *nil* | *nil* | ... | 15⅜ — 16½ | 15⅜ — 16½ | 16⅛ | 15⅜ |
| 20,000 | Do. do. do. 6% Pref., 40,001—60,000 | 10 | 6 % | 6 % | ... | 15⅜ — 16½ | 15⅜ — 16½ | 16⅛ | 15¹³⁄₁₆ |
| 10,000 | House-to-House Elec. Light Supply, Ord., 101 to 10,100 | 5 | ... | .. | ... | 10½ — 11½ | 10½ — 11½ | 10¹³⁄₁₆ | ... |
| 10,000 | Do. do. 7 % Cum. Pref. | 5 | ... | ... | ... | 11½ — 12 | 11½ — 12 | ... | .. |
| 49,900 | *Metropolitan Electric Supply, Ltd., 101 to 50,000 | 10 | 4 % | 5 % | ... | 20 — 21 | 20 — 21 | 20¾ | 20½ |
| 12,500 | Do. Ord., 50,001—62,500, iss. at £2 prem. | 10 | ... | ... | ... | 19½ — 20½ | 19½ — 20½ | ... | ... |
| 220,000£ | Do. 4½% first mortgage debenture stock | ... | 4½% | 4½% | ... | 117 —121 | 117 — 121 | ... | ... |
| 6,452 | Notting Hill Electric Lightg. Co., Ltd. | 10 | 2 % | 4 % | ... | 18 — 19 | 18 — 19 | ... | ... |
| 19,980 | *St. James's & Pall Mall Elec. Light Co., Ltd., Ord., 101-20,080 | 5 | 7½% | 10½% | 14½% | 18 — 19 | 18½ - 19½ | ... | ... |
| 20,000 | Do. do. 7 % Pref., 20,081 to 40,080 | 5 | 7 % | 7 % | 7 % | 10 — 11 | 10 — 11 | 10⅞ | ... |
| 50,000 | Do. do. 4 % Deb. stock Red. | Stock | ... | ... | 4 % | 101 —104 | 104 —107 | ... | ... |
| 43,341 | South London Electricity Supply, Ord., £2 paid | 5 | ... | ... | ... | 2⅞ — 3½ | 2⅞ — 3½ | 3¹⁄₁₆ | 2¹⁵⁄₁₆ |
| 79,900 | Westminster Electric Supply Corp., Ord., 101 to 80,000 | 5 | 7 % | 9 % | 12 % | 18 — 19 | 18 — 19 | 18⅝ | 17⅞ |

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid. § Dividends paid in deferred share warrants, profits being used as capital.

Dividends marked ‖ are for a year consisting of the latter part of one year and the first par of the next.

## SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

### ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL, COMPANIES.

| Present Issue. | NAME. | Stock or Share. ‡ | Dividends for the last three years. 1895. | 1896. | 1897. | Closing Quotation Feb. 2nd. | Closing Quotation, Feb. 9th. | Business done during week ended Feb. 9th, 1898. Highest. | Lowest. |
|---|---|---|---|---|---|---|---|---|---|
| 30,000 | British Electric Traction ... ... ... ... ... | 10 | ... | ... | ... | 18½— 19 | 17½— 17⅝ | 18⅞ | 17½ |
| 90,000 | Brush Elecl. Engng. Co., Ord., 1 to 90,000... ... ... | 5 | ... | ... | ... | 2⅛ - 2⅜ | 2⅛ — 2⅜ | 2 3/16 | 2⅛ |
| 90,000 | Do. do. Non-cum. 6 % Pref., 1 to 90,000 | 2 | ... | ... | ... | 2⅛— 2⅜ | 2⅛— 2⅜ | ... | ... |
| 125,000£ | Do. do. 4½ % Perp. Deb. Stock.... ... | Stock | ... | ... | ... | 109 - 113 | 109 —113 | ... | ... |
| 50,000 | Do. do. 4½% 2nd Deb. Stock Red. ... | Stock | ... | ... | ... | 102 —105 | 102 —105 | ... | ... |
| 19,126 | Central London Railway, Ord. Shares ... ... ... | 10 | ... | ... | ... | 9⅜— 10⅛ | 10 — 10⅛ | 10⅛ | 10 |
| 143,106 | Do. do. do. £6 paid ... ... | 10 | ... | ... | ... | 5⅝— 6⅛ | 5⅝— 6⅛ | 6⅛ | 6 |
| 58,830 | Do. do. Pref. half-shares £1 pd. ... | ... | ... | ... | ... | 1⅛— 1⅜ | 1⅛— 1⅜ | 1⅜ | 1⅛ |
| 61,777 | Do. do. Def. do. £5 pd. ... | ... | ... | ... | ... | 4¼— 4⅝ | 4¼— 4⅝ | 4⅝ | 4¼ |
| 630,000£ | City and South London Railway ... ... ... ... | Stock | 1 1/16 % | 1 1/16 % | 1¼ % | 69 — 71 | 69 — 71 | 70⅝ | 70 |
| 28,180 | Crompton & Co., Ltd., 7 % Cum. Pref. Shares, 1 to 28,180 | 5 | *nil* | ... | ... | 2¼ | 2¼— 2⅜ | ... | ... |
| 99,261 | Edison & Swan United Elec. Lgt., Ltd., "A" shrs, £3 pd. 1 to 99,261 | 5 | 5 % | 5½% | ... | 2¼ - 3 | 2¼— 3 | 2⅞ | 2⅜ |
| 17,139 | Do. do. do. "A" Shares 01—017,139 | 5 | 5 % | 5½% | ... | 4½ - 5½ | 4 — 5 | 4⅝ | ... |
| 110,000 | Electric Construction, Ltd., 1 to 110,000 ... ... ... | 2 | 5 % | 6 % | ... | 2⅜— 3xd | 2⅜— 3 | 2 15/16 | 2⅜ |
| 16,343 | Do. do. 7 % Cum. Pref., 1 to 16,343 ... | 2 | 7 % | 7 % | ... | 3⅛ - 3⅜ | 3⅛ — 3⅜ | ... | ... |
| 91,195 | Elmore's Patent Cop. Deposg., Ltd., 1 to 70,000 ... ... | 2 | ... | ... | ... | ⅛— ¼ | ⅛— ¼ | ... | ... |
| 67,275 | Elmore's Wire Mfg., Ltd., 1 to 69,385, issued at 1 pm. ... | 2 | ... | ... | ... | ⅛— ¼ | ⅛ - ⅛ | ... | .. |
| 9,600£ | Greenwood & Batley, Ltd., 7 % Cum. Pref., 1 to 9,600 ... | 10 | 10½% | ... | ... | 9 - 11 | 9 — 11 | ... | ... |
| 12,500 | Henley's (W. T.) Telegraph Works, Ltd., Ord. ... ... | 10 | 8 % | 10 % | 12 % | 21½ - 22½ | 22½ - 23½ | 23½ | 22⅝ |
| 3,000 | Do. do. do. 7% Pref. ... ... | 10 | 7 % | 7 % | 7 % | 19 — 20 | 19 — 20 | 19½ | ... |
| 50,000 | Do. do. do. 4½ Mort. Deb. Stock | Stock | 4½% | 4½% | 4½% | 110 115 | 110 —115 | ... | ... |
| 50,000 | India-Rubber, Gutta Percha and Teleg. Works, Ltd. ... | 10 | 10 % | 10 % | ... | 22½ 23½ | 22 — 23 | 22½ | 22½ |
| 300,000 | Do. do. do. 4 % 1st Mort. Debs. | 100 | ... | ... | ... | 103 —107 | 103 —107 | ... | ... |
| 37,530 | †Liverpool Overhead Railway, Ord. ... ... ... ... | 10 | 2⅞% | 2⅞% | ... | 11 5/16 - 11 7/16 | 11½ 11⅝ | ... | ... |
| 10,000 | † Do. do. Pref., £10 paid ... ... | 10 | 5 % | 5 % | ... | 16 — 16½ | 16 — 16½ | ... | ... |
| 37,350 | Telegraph Constn. and Maintce., Ltd. ... ... ... | 12 | 15 % | 15 % | 15 % | 39 — 42 | 39 — 42 | 40½ | 39½ |
| 150,000 | Do. do. do. 5 % Bonds, red. 1899 | 100 | 5 % | 5 % | 5 % | 102 —105 | 102 —105 | ... | ... |
| 54,000£ | Waterloo and City Railway, Nos. 1 to 54,000 ... ... | 10 | ... | ... | ... | 13½— 14 | 13½— 14 | 14 | 13⅞ |

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid.

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

Crompton & Co.—The dividends paid on the ordinary shares (which have not a Stock Exchange quotation), are as follows: 1892—0*/16; 1891—7 9/16; 1890—8*/

### LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*** Birmingham Electric Supply Company, Ordinary of £5 (£4 paid), 7⅞, £5 (fully paid) 11.**

**Electric Construction Corporation, 6 % Debentures, 104—106.**

**House-to-House Company, 4½% Debentures of £100, 111—112.**

**Kensington and Knightsbridge Electric Lighting Company, Limited Ordinary Shares £5 (fully paid) 16—16½; 1st Preference Cumulative 6 %, £5 (fully paid), 8¼—8⅜. Dividend, 1896, on Ordinary Shares 7 %.**

**London Electric Supply Corporation, £5 Ordinary, 4¼—4⅜.**

*** T. Parker, Ltd., £10 (fully paid), 12⅜.**

**Yorkshire House-to-House Electricity Company, £5 Ordinary Shares fully paid, 8—8½. Dividend for 1896—6 %.**

* From Birmingham Share List.

**Bank rate of discount 3 per cent. (October 14th, 1897).**

## THE WATT ANNIVERSARY.

At the recent James Watt anniversary dinner of the Institution of Engineers and Shipbuilders in Scotland, Lord Kelvin proposed "The Memory of James Watt" in the following terms:—He had, he said, to thank them for their kindness in allowing him to propose the toast on this great occasion. They had referred to the connection of James Watt with the University of Glasgow. In the apparatus room of the Natural Philosophy Class there now was, he might remind them, the model which Watt was employed by the University to repair in some minor details, when, in considering it, he saw not only what should be repaired, but some of the defects of the principles which it realised, and was led on from that small beginning to the great work which they were met to commemorate. The 19th century, in the eyes of engineers—and if in the eyes of engineers, then in the eyes of the whole world—was the century of James Watt. There were engineers before James Watt. Happier than the men who lived before Agamemnon, their memory was not lost in obscurity for want of the sacred bard and prophet and historian to commemorate their deeds. Tubal Cain was a great mechanical engineer, whose name was a household word in Scotland in the end of the 19th century. Poets and historians had chronicled the works of Archimedes. Skipping 10 centuries, or rather skipping 20 centuries, we came to Smeaton, the man who led up towards the mechanical developments which Watt perfected. Of all the 60 centuries of recorded human history no century had been so great as the 19th in engineering, in the work of applying the laws of matter, and the principles of science for the benefit of mankind. We almost forgot there was engineering before this century. Steam navigation came into existence at Dalswinton Loch, in the East of Scotland, and Symington's boats, after their first trial in 1798, were placed a few years later on the Forth and Clyde Canal. That was the beginning of marine engineering, and what was marine engineering now? It had covered the whole ocean with the works of English engineers. By England he meant—he always meant—England, Scotland, Ireland, India, Canada, and all the other British colonies. Engineers counted other names along with the name of James Watt as being noteworthy in the annals of the 19th century—the names of Faraday and Carnot and Joule. These had all done great things to make the latter end of the 19th century worthy of its beginning with James Watt. The steam engine of James Watt and of the 19th century, was it to be the engine also of future centuries? The latter part of the 19th century opened up new vistas in the application of the works of science, led up to by Watt, and Carnot, and Regnault, and Joule. No man would have been readier than Watt to see the possibilites of other means of producing power than steam. Steam, electricity, and the means of development on which electricity depended would, he was sure, have engaged his attention and admiration, and he would have worked for the promotion of anything that could improve the steam engine. He (Lord Kelvin) believed that we should have ships driven by steam power for at least 100 years yet. We might safely say, so long as our coal supply lasted—a good many hundred years—steam power would keep alive directly the results of the labours of James Watt. He would not prophesy that in any respect, even for land use, other agents would supersede steam, or that the 20th century would be the century of oil and gas and internal combustion engines. Engineers, however, should be interested in the question—"Was the internal combustion engine going to supersede the steam engine?" Whether it did so or not, for any larger application than we now had the gas engine, we should have no less reason to be grateful to James Watt. At the end of the 20th century his name would, he believed, be received with as much respect and gratitude as it now was. In pure science Watt was a leader. He (Lord Kelvin) remembered that his great master in physical science, Regnault, had "la loi de Watt," the law of Watt, with relation to the latent heat of steam always upon his lips. It was a matter of great joy and perpetual pleasure to the University of Glasgow that it had had the honour of having given Watt encouragement in the early days of his studies, and that in his workshop at the University, the Scientific Society, the Philosophical Society, and the Physical Society came into existence. These had been the parents of many similar societies all over the British dominions, with what tremendous benefits to mankind they all knew. Let them think of living now as compared with living 100 years ago. Some people asked, were we happier or better by reason of these wonderful inventions and discoveries? People, he might reply, were happy and good, and sometimes neither happy nor good, during the 60 centuries that preceded James Watt. But we had social advantages now that no human being had before 1800—the advantage, for one thing, of being kept continually in touch with our friends. Engineers did not look upon the application of their craft merely from a mechanical point of view. They knew that their steamers and railways were of great direct benefit to humanity. He had in his pocket a telegram from

India describing the recent eclipse. It read—"Eclipse well seen, also red flames and Baily's beads. Some very fair photographs. The whole party well satisfied." The message reached him the forenoon of that day. The writer, a man 80 years of age, went all the way to India to see the eclipse, and to try to contribute something to the knowledge to be obtained from it. The telegraph, some might say, was not one of the benefits derived from James Watt's labours. He said it was, because without the marine engine and steam navigation they could never have had the ocean telegraph, which in itself was a great blessing to the world. The world to-day was happier and better in every respect for the work of James Watt, and he asked them all to receive with due honour the toast of his memory.

## THE PACIFIC CABLE.

(*Concluded from page* 164.)

The Eastern Extension Company represents a combination of associated companies engaged in telegraph transmission between England and Australasia. The lines of the company comprise those of three amalgamated companies:

1. The "British Indian Extension," from Madras to Singapore, with a share capital of £460,000.
2. The "British Australian," from Singapore to Australia, with a share capital of £540,000.
3. The "China Submarine," from Singapore to Hong Kong and Shanghai, with a share capital of £525,000.

The combined share capital of these three companies amounted to £1,525,000. On their amalgamation the united share capital, by a well-known process of "watering" to the extent of £472,500, was increased nominally to £1,997,500. The united company, since known as the Eastern Extension Australasia and China Telegraph Company, Limited, has been exceedingly prosperous; it has paid 7 per cent. on the enlarged capital, equal to 9 per cent. on the original capital. An examination of the published statement establishes that it has in addition expended out of the profits earned, no less a sum than £1,571,540 on extensions and other productive works, and there remains unexpended and undivided to-day a reserve of surplus profits amounting to £804,193.

These figures establish that the Eastern Extension Company has become a remarkably profitable investment. It regularly pays good dividends, but the dividends are no guide to the profits made. It holds in reserve undivided profits far exceeding in amount the whole value of its cables between Asia and Australia. The accounts of the company for 1896 and the first half of 1897 show that the net profits actually earned during these periods amounted to 13 per cent. on the present capital, and 17 per cent. on the capital prior to its being watered.

The company is unwilling to have this state of affairs changed. They know perfectly well that the telegraphic traffic is steadily increasing, and that as the traffic grows the profits will become still greater. It is easy, therefore, to understand why the company has never viewed with friendly feeling the proposed Pacific cable. Its managers are not willing to divide the business with the new line. They must retain it entirely in their possession. They have secured a rich monopoly, and their desire is to make it even more profitable, and to strengthen and perpetuate it.

The Pacific cable has been projected in no spirit of hostility to any company or to any country. It has been advocated as a means of extending to the whole Empire the advantages derivable from the geographical position of the Dominion. Canada offers the connecting link in an Imperial chain of telegraphs encircling the globe. When the project is completed, it will bring the mother country into direct electrical connection with every one of the great possessions of the crown in both hemispheres, without touching the soil of any foreign power. Thus it cannot fail, in a high degree, to promote Imperial unity. Indeed, it is difficult to conceive how a perfect union, or any union of the whole, is possible without union between the parts. The whole Empire is in strong sympathy with the aims and aspirations which a few years back were limited to a few men of advanced thought. The historical event of last June has shown to the world that "the British people are one people, animated by one spirit." It is recognised that we are approaching the period when new relations may be established between the United Kingdom and those younger British communities beyond the seas, known in past history as colonies, but which are passing from colonial tutelage to a higher national status. In order to promote these closer relations, what is more desirable, what more necessary, than that each and all be connected by the appliances which art and science have devised? Canada stands first among the British communities of the outer Empire. Scarcely second to Canada we look forward, in no long period, to welcome the kindred Dominion of Australia, comprising under one federal government half a dozen colonies, each possessing great potentialities. What more in harmony with the spirit of the British people than that Canada and Australia be brought in close communion? Is it not indispensable to vital public interest that those two great units of the Empire—the island continent in the South Pacific and British North America, should possess the means of instantaneous communication, one with the other?

The proposition of the Eastern Extension Company submitted to the Conference of Premiers has no such purpose in view. Its object is indeed the very opposite. While the consolidation of the Empire demands that the Queen's subjects in Canada and Australasia shall possess all the advantages which the closest telegraphic connection can effect, the policy which animates that company would cause these communities to remain severed. Is such a policy to be commended? Does not the Eastern Extension Company when persistently exercising its manifold and widely ramified influence to keep Canada and Australia disunited, assume an attitude of hostility to both countries and to Imperial unity?

In the interests of the Eastern Extension Company the Pacific cable has been declared to be impracticable; its cost has been greatly exaggerated; it has been denounced as a work which could not be maintained without burdensome subsidies; it has been stigmatised as inimical to telegraphy and trade; and it has been decried and misrepresented in every possible manner. The explanation is to be found in the fact that the company is unwilling to relinquish its monopoly and to rest satisfied in the future with a reasonable return for capital invested. On this point the writer is tempted to quote a single paragraph from his address at the Colonial Conference of 1894 as given in the proceedings (page 85).

"The progress and well-being of Canada, Australasia, and the Empire cannot be retarded in order that the lucrative business of a private company may remain without change. Even if the chairman of the Eastern Extension Company succeeded in converting us to his commercial ethics, that the profits of the monopoly he represents must be maintained inviolate, it does not follow that the project of a Pacific cable would not be carried out in some form, even if Canada and Australasia abandon it. There are indeed unmistakable signs that a Pacific cable may shortly be carried out by France and the United States. We all know that France has already completed a section of 800 miles at the southern end, and the United States has recently expended $25,000 in making an elaborate survey of about one-third the whole distance from San Francisco (to the Hawaiian Islands.) With a rival line in foreign hands, it is easy to see that the Eastern Extension would gain nothing, while the Empire would lose much."

With respect to the objections raised by the Eastern Extension Company, they have been completely refuted. The very best evidence shows beyond all question that the project is perfectly feasible, that the cable should be established as a State work, that, so established, the revenue from business obtainable will be ample to meet every charge, including working expenses, maintenance, renewal, interest on cost and sinking fund to replace capital; that in fact, the cable can be established in the most satisfactory manner, and that all its advantages can be attained without any cost whatever to the taxpayer. That the prospects are of this character is attributable to these facts, viz.:

1. As a State work, the capital employed would be obtained at the lowest possible rate of interest.
2. The capital would be limited to the necessities of actual expenditure in establishing the work; there would be no possibility of enlarging the capital account by adding "promotion expenses" or by "watering stock" in any form.
3. No dividend would require to be declared, or bonus paid. Revenue would only have to meet ordinary charges, including interest on the actual cost at a low rate, possibly 2½ per cent.
4. Remunerative traffic which would be controlled by the Australasian Government already exists.
5. Such traffic is continually growing, and it is difficult to assign a limit to its growth.
6. The facilities created and the reduced charges would open up a new and profitable business across the Pacific which would be subject to the new line.

Such being the case, the question may be asked, is there any reason other than the opposition of the Eastern Extension Company why the establishment of this important national work should be farther delayed? It must be admitted that the Pacific cable in operation would put an end to the monopoly of the Eastern Extension Company and diminish the immense profits it enjoys. As, however, less than half the whole traffic would prove remunerative to the Pacific cable, there would remain ample business to the company to yield a good return for the capital invested.

In the memorandum laid before the House of Commons last July by the Secretary of State for the Colonies, it is distinctly indicated that, while the Home Government is willing to co-operate with Canada and the Australian Colonies, the Imperial authorities are unable to see the way to take the initiative, and that they "now await definite proposals from the Colonies interested before proceeding further in the matter." It unfortunately happens that the Australasian Colonies remain under the disadvantage of being disunited politically, and they are not all equally in favour of the Pacific cable, Western Australia and South Australia being somewhat in sympathy with the Eastern Extension Company. New Zealand, New South Wales, Queensland and Victoria desire to have the cable laid on the Canadian route. As the traffic to make it a profitable undertaking would have its source chiefly in these colonies, and, moreover, the land lines within each colony are owned by each respective Government, they have it in their power to control the trans-Pacific telegraphic traffic to the extent required to make the cable a profitable undertaking.

At this distance it is not easy to understand why these four colonies do not agree to take some definite line of action. It is now close on six months since the Premiers met in London, and, as far as known, they have not seen their way to agree on any joint proposal, owing, doubtless, to unexplained local difficulties.

Under these circumstances it is not improper to consider if there be any duty or obligation resting on us in Canada. The Dominion is now looked up to as the elder brother in the British family of kindred nationalities. If, as Canadians, we have faith in our destiny as no inconsiderable element of the great Empire, are we not called upon again to take the initiative? The mother country awaits a proposal. It cannot well come from disunited Australasia. If we are to be brought within speaking distance of the kindred communities in the southern seas, the first impulse must come from ourselves. Shall the

opportunity which circumstances have presented be seized, and another proof given to the world that "Canadian Government and people are determined, in all ways, to promote Imperial unity?"

SANDFORD FLEMING.

## A SURVEY OF THE POSSIBILITIES OF ELECTRIC HEATING AND COOKING.*

BY W. P. ADAMS, A.K.C., A.I.E.E.

(*Concluded from page* 163.)

THERE is one direction in which one might anticipate a large development of electric cooking, and that is in flats. If architects will arrange for a general hot-water supply for the whole building, as I believe is now done in many cases, electric cooking presents such an advantage that an important movement in this direction should take place when the supply companies are convinced of the advantage of charging such prices as will be generally acceptable. I think I have said sufficient to indicate that even with electricity at 3d. per unit, electric cooking is not extravagantly expensive, and if its other great advantages are taken into consideration, particularly the economical results from the perfection of the cooking, it ought to be received with prompt favour.

I am hoping that before long those responsible for electricity supply will begin to make a definite move in the development of electric heating and cooking. It is not sufficient to merely reduce the price of electricity to a reasonable figure, as many of the Corporations have already done, but steps should be taken to induce people to become users of electricity for other purposes than lighting. The hire system, which the gas companies are much in favour of, should be adopted where possible. One of the difficulties which has been met with in the attempt to develop electric heating is the high first cost of the apparatus. This is largely owing to the comparatively small output of heating apparatus at the present time, and is also owing in no small degree to the many different voltages which the goods have to be made up for. You will probably be surprised to learn that there are no less than 14 different voltages in general use at the present time, and you will quite appreciate that this does not tend towards the cheapening of the appliances.

I have little doubt, if supply companies are prepared to give this matter their careful attention, that mutually satisfactory arrangements might be come to between themselves and manufacturing firms so as to meet these difficulties.

I have now to consider the practicability of using cooking and heating plant in connection with plant installed for lighting residences and factories.

In very few and well-arranged and properly-managed private installations does the cost exceed 4d. per unit, and in residences where accumulators are used it would simply mean running the plant a few hours a day extra if electric cooking apparatus were adopted.

In factories where large electric lighting plants are in use, the same argument holds good. The probability is that the generating engines are supplied with steam from the main boiler system, and the man in attendance on the general machinery is expected to look after the electric lighting plant. The cost of generating electricity during the daytime for cooking meals for the staff of this establishment, and perhaps for the employés, is, in such a case, almost a negligible quantity.

I must here make a small digression to call your attention to the curious ideas some people hold with regard to electric cooking. An establishment in Liverpool has just installed a large and economical plant for electric lighting purposes, and it had been proposed to the owners that they should use it during the daytime for cooking purposes. I was asked by the electric light contractors to loan some apparatus for testing, and the conditions being distinctly favourable, this was done. A little later I was informed that the committee would not adopt electric cooking. I was anxious that the test should have been made under my supervision, but it was not thought necessary for me to be present. Inquiries were made, and I found that the committee itself had superintended the experiments, and had insisted upon the food being placed on the appliances before current was turned on. As one of the elementary rules of cooking is that the apparatus should be heated up to the proper temperature before the food is placed upon it, you will understand that such an experiment was foredoomed to failure. I relate this instance as an illustration of the common idea that electric cooking apparatus is capable of doing things which no one would think of expecting from ordinary cooking apparatus, and simply for the reason that the word "electric" is used in connection therewith. Every electrical engineer, at one time or another, has met with peculiar ideas of this sort.

There is nothing, of course, nothing magic about electric heating and cooking appliances. The advantages which we claim for them are: (1) That they are more economical in point of heat utilised than any other appliances; (2) that they are quite without equal in point of cleanliness and general convenience; (3) that there is practically no waste of material in the cooking; (4) that by their means cooking is reduced to a simple science, and absolutely uniform results can be obtained, this being due to the ease with which the heating effect is controlled by switching. In the oven it is usual to fix a thermometer, indicating on a dial on the front of the door, and given temperatures can be maintained within a few degrees. I might further claim that such appliances are perfectly free from such dangers as attend the use of gas cookers. Explosions are impossible, and the risk of fire is nil.

I must now beg of you to spare me a few minutes for the consideration of electric heating by radiators.

I have already indicated at the commencement of this paper that this subject requires consideration from quite a different point of view to electric cooking. Assuming for the moment that there is likely to be any large development, you will at once observe that this will bring no load to the stations during the summer time, and, owing to the large amount of current the radiators consume, they will make the winter load heavy. It may be that persons who adopt electric cooking may be inclined to use the apparatus during the summer time only, on account of its coolness, in the same way as people now adopt gas ovens, returning to the use of the kitchen range in winter. If this were done to any large extent it would probably meet the difficulty, and it might even be desirable for supply companies to give special terms for the use of electric cooking appliances in summer, and increase these charges during the winter. Whether such a plan is feasible or not will have to be ascertained as the problem develops.

When estimating roughly what current radiators are to be wound for, for a given space, I generally assume that 500 watts will be necessary per 1,000 cubic feet of space, in the coldest weather. This, of course, is only a very rough guide, and in every case the general conditions must be taken into consideration. In my office in the City, which has a capacity of 2,000 cubic feet, with one outside wall almost entirely consisting of window space, I rarely use a larger radiator than one absorbing 600 watts. In very sharp weather I have found it necessary to put two of these on for the earlier part of the morning, and sometimes on Mondays, after a continued frost extending over Saturday and Sunday. In this instance it will be seen that a less quantity is required than 500 watts per 1,000 cubic feet of space. In the case of a building with several thin outside walls, and other unfavourable conditions, probably more than the 500 watts would have to be provided for.

With radiators consuming this amount of energy you will appreciate that electric heating is not likely to receive much support when such charges as 8d. per unit are made. At the beginning of last year I was requested by an architect to fit nine radiators in a spacious office in the city. The firm was a wealthy one, and expense was not considered an important matter owing to the convenience of the electric radiators. I pointed out before the order was placed that the cost of current would probably be very high; but, notwithstanding my warning, it was decided to have the radiators fixed. After they had been running for three or four months I was informed that the cost was so excessive that their use would have to be discontinued. With one or two small exceptions these are the only radiators ever installed in the city of London; and, while the prices are maintained at the present figure, little development is likely to take place; and yet the City is an almost ideal place for the use of electric radiators, owing to the fact that the bulk of the offices close at an early hour, and that the occupiers are willing to pay a good price for so convenient and sanitary means of heating as electric radiators provide.

Experience shows that even at so high a figure as 3d. or 4d. there is considerable demand for electric radiators, and this is not surprising when one considers that the heat produced is of exactly the quality that one could desire. It is not sufficiently high to deprive the air of its moisture. There are no products of combustion to vitiate the atmosphere, and the radiators are turned on and off with the same ease as the electric light.

I cannot now make detailed mention of the smaller heating appliances, but I think that their employment is one worthy of some consideration by supply companies. If they are at all largely adopted, they would be of value in increasing the day load, and it is likely that they would be employed at times when the cooking apparatus would not be in use. Take, for instance, the electric kettle. Each kettle takes from 300 to 500 watts, and they are mainly used for preparing tea in the afternoon. It is conceivable that, if used in large numbers, they would help to fill up the somewhat awkward dip in the curve occurring about 3 or 4 o'clock in the afternoon, after the hot cupboards and plates had gone out of use.

In conclusion, I will ask you to be as lenient as possible when passing judgment upon this paper. I am well aware that I have been guilty of some temerity in venturing to read a paper upon a subject about which there is so little practical knowledge. My excuse for doing so is, that I believe there is a reasonable probability of considerable development in this direction in the near future; and I hope that the figures which I have placed before you may help electrical engineers and others interested to understand better the claims that this branch of electrical engineering has upon them. I have attempted to deal with the problem as widely as possible, and I hope that the aspect of affairs from the central station engineers' point of view may receive some consideration during the discussion.

* Abstract of paper read before the Northern Society of Electrical Engineers.

## ELECTRICITY IN THE MACHINE SHOP.

THE severity of misfortunes is often mitigated by subsequent benefits arising, which are the better available because of the very conditions caused by misfortune. As an example of this, which the near future is placing to the hand of English manufacturing engineers, we may name the engineers' strike, and the tactics which led up to it. We have pointed out that the restrictive action of trades unionism has been

responsible for the continuance in use of thousands of old-fashioned tools, which their owners are perfectly well aware could be economically replaced by new and improved tools of greater output *capacity*, and doubtless this would be done if only such new tools were allowed to work at their proper speeds. American visitors, never at a loss to cast a sneer at English shops, have not failed to note the slow speeds at which tools are driven in union-ridden shops, while perhaps themselves subscribers to the American fund which is being raised to maintain restricted output. As we may hope the near future will see an entire change in English shop management and tool using, it is reasonable to anticipate that there will be a very large demand for new machine tools, and it seems opportune that we should endeavour at this probable crisis to draw attention to the very great economy of electrical driving of machine tools, and to the extreme desirableness of entirely changing the practice as regards machine tools. To some extent in this country, but to a much greater extent in America, the driving of tools electrically has made rapid progress since the year 1894. Modern American shops fitted with new tools have found to some extent that the application of the new motive power transmission has not been possible to be carried to its most economical extent, and to the larger tools there has been required a good deal of extra fittings, while smaller tools have been banked, as it were, upon an electrically-driven shaft, that would have been better driven independently. In fine, electricity has been rather a graft upon an already grown tree than a naturally grown branch. Could we see 20 years ahead, it is probable that a continuance along the lines now opening out would carry us to the time when the demand for small motors would have been met by their supply, and that machines driven by shafting will be almost, or wholly, superseded by machines with their own motor, just as large machines have now their own separate motor. Further, we think the future will see a very great change in tools themselves. There will be more portable tools carried about by overhead cranes and attached to the work, in place of, as now, work being taken to fixed tools. One of the complaints against trade unionism is, that under its rules one man must attend to one tool only. Machine tools seem to be now working under parallel conditions. One piece of work can only be operated upon by one tool at a time. An example of how electricity will change this is to be seen in an illustration of the drilling of a large casting in the shops of the General Electric Company, at Schenectady. The cumbersome casting is hung up in chains to be drilled by a radial drill, which is perhaps about the first step in the carrying of a machine tool to its work, and has made the radial drill so popular and successful. On another page (*Cassier's Magazine*) the same casting is shown lying safely on the floor and being operated on by two portable slotters and a portable drill, all electrically operated. In present practice, or shall we say old practice, huge machines are required even to drill small holes if the piece drilled is large. The size of machine tools has in fact been measured by the bulkiness of the things being made. There is no reason whatever that a ½-inch drill should be carried by a 2-ton frame. Carry the drilling machine to the work and at once the tool is reduced to what is necessary to drive the ½-inch drill. Machine tools will be small and portable. They can be attached by the half-dozen to a big casting, and work in future will be dumped down at a convenient place in the shop, where it will remain till finished. The lathe and the large planing machine may perhaps still remain fixtures, and have work brought to them, but drills, cylinder boring bars, slotters and shapers will be smaller than of old, and will be portable, and as, perforce, they will require to be separately driven, the small motor is bound to make its appearance.

How does all this bear upon our prefatorial remarks? Simply that the impending change of practice with its consequential demand for new tools will or should be made coincident with the new system of driving, and the new tools ought to be fitted to serve the new driving arrangements.

The economy of electrical driving arises largely from the abolition of shafting, steam piping, &c., and the concentration of steam plant at a centre. It does not necessarily follow that the total abolition of all intermediate gearing between the motor and the actual tool can be effected economically, and, in drawing attention to this point we might quote Mr. Mullin, to whose article we have referred, to the effect that two notable instances of direct-driving have signally failed, and been replaced by gearing, in one case, at least, of a comparatively discredited variety. One is that of the geared trolley motor which replaced the direct torque armatured axle. The other case is the bicycle, the high direct-driven machine being entirely displaced by the chain-geared safety, the serious disadvantages of the chain being partially eliminated by the dust-proof case and partially overlooked in the desire to bring the C.G. of the loaded machine further behind the point of support than possible in the high machine. But the use of gearing is essential to small and light motors, and is likely to continue.

It would be well that our manufacturing engineers should very seriously consider the system of electric driving, and the various changes it makes possible before re-organising their shops. Machine tool makers also should be prepared to meet the new demand which is likely to be made upon them. If our views be correct we may say that the harassing tactics of trades unionism have delayed the improvement of our workshops until the improvement can be made wholesale and thoroughly—men, methods, machines and motors all moving together. There has got to be a change, and when it does come it will be thorough, as customary in England, where we are apt to stick a long time in our grooves, but when we do leave them we are thorough.

In America, to judge from Mr. Mullin's illustrations, electrical driving has been largely adopted to old machines as well as applied to new ones, and the result is very mixed, the motors often having a temporary appearance; but there is apparently a strong desire to secure the new driving at any cost, so great are its advantages, and in one large shop it is said that 4,000 hands are now doing the work of 6,000, and with an increased output of 60 per cent. This is a rail rolling mill which has utilised mechanical power to the utmost. Need we wonder that America is now sending rails abroad, and, no doubt, finding such work as will more than provide for the 2,000 hands above thrown out.

We need hardly point out that the saving effected in the size of the bulk of tools, and the reduced dimensions of the buildings necessary to contain them, as well as the lighter construction possible will, in the case of a new works, probably outweigh the cost of the electric motors, and all this saving would be additional to that of the motive power, of oil, belting, and attendance. The modern engineers' shop should, in fact, be simply an area commanded by a traveller arranged to convey the pieces of work to the heavy tools, and to carry the lighter tools to the work. The motive power would be placed anywhere most convenient. In fact, the motive power would usually be placed near the forge, so as to be convenient for supplying steam to the hammer. All driving would be electrical, and warming would be done by steam. When not in use, the portable machine tools would be stacked in close array, not filling much space. Machine tools would be much more saleable than they are to-day, and it would be possible to borrow tools to tide over any special push of work. This cannot be done where tools are bedded down and belt driven.

## TECHNICAL LITIGATION AND THE QUESTION OF GOOD WORK IN HOUSE WIRING.

By V. ZINGLER, A.I.E.E.

(*Concluded from page* 103.)

We may now turn to the second subject of the title, which has only been introduced here because, in the case referred to, it was made a position of by the defendants; but, owing to a weak point in their defence, they were driven out of it, and the battle was decided on lower ground. It is, of course, almost impossible to standardise the quality of work that is done in house wiring; fire insurance offices have attempted it; the Institution of Electrical Engineers have drawn up rules to be observed; every supply company has regulations which must be complied with; consulting engineers draw up elaborate specifications; and even wiring firms themselves

make out their own specifications, without which the average customer forms a poor opinion of them. And what does it all come to? Can each and every one of these bodies have a representative continually on the spot to see that their rules are observed? If not, with whom does it primarily rest to carry out, if not every rule that has been made, at least such an average standard of work as shall meet the requirements of all the parties concerned? There is no doubt it lies with the firm itself; it is a question of commercial morality and nothing further. The quality of material supplied, the honesty of the foreman, the training of efficient workmen, and the adoption of a proper system of work and of superintendence are all factors in the respectability and standing of the firm; and indicate whether their policy is to be one of getting work at all costs, or of combining the making of a fair profit with work which is a credit to themselves, and studies their customers. It is impossible for the foreman to be honest if he sees that his firm is supplying inferior material, and deceiving the customer; it is still less possible for the workman, who takes his cue from his foreman and the general style of the firm, to avoid scamping his work. He wants looking after enough in most cases, but he is also only human, and endeavours to do his best to please his present masters. And so, when he finds that it is a "nigger driving" concern, and that he is expected to get through the work quickly, with no question as to what lies underneath, why he does it. Firms of this sort are unfortunately very common; it is only necessary to look at the comparative list of tenders often appearing in this Journal to see the great and perfectly unintelligible variations in estimates; these show the electrical trade parasites, the firms whose life may be described as a constant harmonic motion between business or partnership notices and liquidation notices. At the end of each period there is a re-incarnation consisting of a new combination of sells (the pun may be pardoned), and during their short life they manage to do a certain amount of bad work, which also lies dormant for a time, but which, on the application of 220 volts or a little moisture, comes forth from all corners to annoy the customer. Turning to the estimates above referred to, it may be asked why it is that these differ so very much. We have said that this is unintelligible, but this is really only so on the face of it. Let us analyse an estimate. It consists of three parts: material, labour, and contingencies. Now, when quoting to a specification with schedule of lights, the material is a fixed quantity, and its cost may be said not to vary more than about 10 per cent.—speaking only of wiring material, and not plant. It is, of course, possible that some firms do not take as much trouble as others in measuring up for wire and casing, but even this does not make a large difference. It is on the question of labour and contingencies that firms go wrong. Only those who have had plenty of experience in all kinds of wiring work, and lived through it, know how great the uncertainty of time and labour is; building not finished, fittings not ready, unexpected surprises in the way of girders, floors, and walls. These and many other things have to be allowed for if the firm is going to make a profit, or if they are not going to scamp the work. And if these things have not been allowed for in the desire to obtain an order, and are met with when the job is under way, the temptation to try and make the cost keep below the tendered price is no doubt very great. In confirmation of these views, it may always be observed in reading through a list of wiring tenders, that the best-known (and, of course, most experienced) firms are at the top. And it will be found that the firms who do the best work are those who, to begin with, have a conscience; who set about a job with the idea of providing the best material and labour at a fair profit; who do not persuade their customers to take what will not be necessary for their requirements; who have honest foremen and a good system of superintendence; and who have a standard of wiring work from which they refuse to deviate, and to which they have trained a few good wiremen whom they keep. These may be said to be the ethics of the wiring question, and they may be summed up in a remark frequently made by a firm (who conforms to them) when a customer asks, "What will it cost?" "My dear Sir, you can get it done for anything you like!"

It may now not be inappropriate to discuss the various details of wiring work in which the question of good work arises, and especially those which came before the Court in the case we have in view. On this occasion a great deal of nonsense was talked about the "tree" and the "sub-circuit" systems. Because one witness had said that the latter system was the most recent of the two, counsel fell upon it, and dubbed it the "new" system; and this was so insisted on, that there is no doubt that in the mind of the jury it was clear that the plaintiff had not put in this system because he had only himself just heard of it. As a matter of fact, it may be said to be many years old and to be the result of the excellent fire insurance rules which tended to put electrical wiring into something like shape. The "tree" system is certainly antiquated, but there are occasions when it must be used, such as in the wiring of long, straggling sheds with few lights in each. It is even then necessary to fuse each main at every point where it is reduced in section, and also to fuse each light separately. Any failure to comply with this is not only bad work but gross negligence and carelessness. As regards the "sub-circuit" system, this is the only system now used for good house wiring, and on the double-wire system it cannot be said to be complete, safe, or good work unless it consists of D.P. fuse and switch for mains, distributing board with D.P. fuse and switch on each circuit, and fuse board at the end of each circuit provided with D.P. fuse for every sub-circuit, to consist of not more than seven 16-C.P. lamps on each. It is not the object of this article to draw up a specification; but it may be added, without going into the question of material of floor boards, that the poles should be kept apart by an air-space, and that all holes for fixing screws should be well bushed. The failure to do this is a frequent cause of leakage, which leads to other things.

Another point discussed in the case was that of "dry joints." How such a term has ever arisen it is impossible to say, as it cannot be too strongly pointed out that such a thing as is understood by "dry joint" should never have existed, not even on temporary work. It may be said to be an aggravated form of *the* only danger of fire in electric wiring, namely, increase of resistance, and consequently of heat, due to the interposition of a section of lower conductivity, without a fuse to protect it. How any man calling himself an electrician, much less an expert, can go into the witness box and say that there is no harm in a dry joint, passeth understanding. He might, with equal assurance, describe himself as a truthful man.

We next come to the question of casing and bunching of wires. Here experts may even be allowed to differ, as the arguments *pro* and *con* have equal reason. In pipes, where wires must be bunched, the only dangers are caused by bad work; *i.e.*, burrs which may tear the wire, or bad wire which may break down. In either case an arc may be formed, but if the general insulation from earth is good, and the circuits are properly fused, this will not occur. The remedy is to avoid these causes. But as regards wood casing, there are dangers from other causes; *i.e.*, rodents, water and mechanical injury. The use of wood casing is only a temporary remedy against all three. The best remedy against water is to use good wire, and the only remedy against all three is not to use the casing but iron pipe. It may, however, be said that if casing has to be used, it must be used everywhere, if only for the sake of tidiness, and if it is omitted under the floor boards it may also be omitted on the walls. But in the latter case the customer sees it, and in the former case he does not. The conclusion is obvious if good work has to be done.

The only remaining important point is the wiring and fixing of fittings. More bad work may be done at this point than anywhere else on the installation. There is a common belief amongst careless wiremen that there should be a joint for every fitting. Every joint is an increased weakness to the system, and may be likened to the weakest link of a chain—the strength of the chain. But two bad joints are worse than one weak link, as they double the leakage and the source of danger.

In the case of most ordinary plain fittings, such as brackets, tube-pendants, &c., the wires should be left long enough to run right into the lampholder, with a little to spare; this should be coiled up in the back-plate or in the floor above. There are, however, some fittings, designed by artists, and not engineers, where no proper provision is made for wiring. In these cases flexible wire has to be used—that is, while people will buy such fittings—and not only is it customary to make

joints here, but the flexible wire is twisted about outside the fittings and bound round by wire without any regard for possible consequences. What is more, the wire used is frequently not vulcanised, also to economise space. The dangers are self-apparent. The remedies are—not to buy badly designed fittings, or to have them altered if necessary; if the fittings must be wired with flexible wire, let it be vulcanised, and fix a small china cut-out in the wall behind or above (as the case may be) the fitting back-plate.

If even this is impossible, and it is necessary to make a joint, the flexible wire at the point of jointing should be strengthened by winding the fine wires round a piece of copper wire of equal section to the circuit wire; the whole should then be soldered together, and well protected.

No flexible wires should pass through metallic back-plates or other metal parts without an insulating bush. In fact, such a thing can only be the result of accident or ignorance. The question of wiring of fittings was fully dealt with by the writer in this Journal some time back.

It is, however, clear that the trouble of fitting joints will always exist more or less until some manufacturer of fittings, more energetic than the rest, will devise and standardise a complete system of male and female sockets for fittings; the male to be in the back-plate and to be wired to the lamp-holder; the female socket to be fixed as a "point" on the wall or ceiling, and wired back to the fuseboard. The fitting would then make electrical contact just like an ordinary plug and shoe, and it would be secured to the wall by the usual method now employed.

The slight extra cost of these sockets would be met by a more than corresponding reduction in labour of fixing and making joints, not to speak of the convenience of being able to change the fitting if desired. Such a system should commend itself to ladies, who, according to the plaintiffs' experience in this case (and the experience of most other electricians) are never satisfied with a fitting when it is fixed up. The best way to deal with such people is not to make dry joints, so as to lessen the trouble of taking down the fitting next time, but to provide the wireman with a book of order forms to be signed by their customer or his wife whenever an extra of this sort is required, and to charge these up at the end. It will be found an excellent method for suppressing the lady's enthusiasm for changing fittings.

Finally, it is of no use abusing Fire Insurance and Supply Companies' Rules unless something better can be suggested, and if both are adhered to as far as possible, with a due feeling of responsibility and interest in the work, and a proper look round and inspection afterwards, there should not be reason for such lawsuits or for any accusations of bad work. It can only be urged that the test as made by the Supply Company shows absolutely nothing as to how the work has been performed, and a man who goes round with a boy and an ohmmeter and generator has no means of proving anything else than that the insulation resistance of the installation is not low enough to cause serious loss to his employers. Even then cases have been known where the mains have been disconnected at some point for the test, and joined up before the lamps were put in, to show that there was complete continuity.

It cannot be too strongly urged on the public not to listen to touts who call at their houses and ask to be allowed to estimate for the electric lighting, nor to accept the lowest tender invariably because it is the cheapest. It will, without doubt, cost them more in the end than if they accepted the dearest tender. Far better is it to engage the services of a capable consulting engineer with good references, to pay him, say, 5 per cent. on the cost, and to know then that he will take full responsibility for the choice of a good firm, and for the due carrying out of the contract according to his own advice and experience.

## SOME ELECTROLYTIC PROCESSES FOR THE MANUFACTURE OF WHITE LEAD.

By SHERARD COWPER-COLES.

Up to the present the old Dutch process of making carbonate of lead has held its own, and it is still the impression that the lead produced by this process is the best as regards its covering capacity. Such was the finding of the Committee appointed by Government to investigate the dangers attending the manufacture of white lead. Carbonate of lead, manufactured by a wet or electrolytic process is found to be more or less crystalline and hydroscopic, and has not the same covering power as white lead manufactured by a dry process.

The amount of white lead produced on the Tyneside is 16 to 17,000 tons a year; a similar amount is produced in France; Italy producing about 3,500 tons a year.

The old Dutch process consists in subjecting desilverised metallic lead (blue lead) which has been melted and cast in wickets (also called crates) which are sometimes in the form of gratings or plates with two holes and a central flat rib to the vapour of acetic and carbonic acid. The wickets are put into stacks or blue beds for corrosion into white lead. This is done as follows:—The floor of the stack, a large cubicle built of bricks, is first covered with a layer of tan, on this are arranged as closely as possible stoneware pots filled with dilute acetic acid, and on the top of these are placed four or five layers of wickets in close contact with each other. The whole is then covered over with boards, forming a second floor upon which fresh layers of tan, pots and wickets, are arranged as above. This is, in its turn, covered in the same way, and so on until the stack is full; as many as 10 or more layers going into one stack. When the stack is full, the ventilating shafts which have been left at each corner of the stack are closed up, and the stack is left to itself for periods varying from 10 to 15 or more weeks. During this time the conversion of the blue lead into white lead takes place. The tan soon begins to heat and evolves carbonic acid, the heat volatalising the acetic acid. An inter-action then takes place between the lead on the one hand, and the carbonic acid, acetic acid, and air on the other, leading through a series of chemical changes not clearly understood, to the ultimate production of an amorphous basic carbonate of lead (white lead); the action goes on until either all the lead is corroded, or all the acetic acid has been volatalised, or no more carbonic acid is produced. During these changes there is always a small proportion of acetate of lead present in the corrosion, some of which is also left in the final product. At the expiration of the time found necessary by experience the stack is opened, and the corroded lead is wetted and carried away in trays to corrugated rolls over which passes a constant stream of water; in front of these rolls the corroded lead is tipped down. In passing between the rollers the wickets are crushed, thereby detaching the white lead from any remaining blue lead. The crushed material next passes into a shallow tank having a perforated bottom, in which it is raked about, separating the blue from the white lead. The blue lead is raked out; the white lead passes with a current of water to grinding mills, where it is ground up and run into a series of tanks; in these the finely divided white lead settles to the bottom, the water is then drawn off, the white lead is removed, put into earthenware or copper pans, and placed in drying ovens. When the white lead is thoroughly dried, which takes from three to five days, the pans are taken from the ovens by hand labour, or mechanical means, and the dry white lead is placed either into casks, or thrown into bins for subsequent conversion into paint.

White lead (carbonate of lead) has two faults, as it is both poisonous to the makers and to the users. The perspiration on the hands has an acid reaction, and tends to dissolve some of the white lead, and this passing into the system, gives rise to lead poisoning. Lead has the property of accumulating in the system, and when a certain amount has got in the system, it is very difficult to eliminate. The other defect alluded to is that of discolouring on exposure to air and sulphurous gases, with which it forms black sulphide of lead.

From the foregoing description it will be seen that the Dutch process is a very slow and tedious one. To overcome these difficulties the following system has been devised. The lead is cast into thin sheets about 20 inches by 15 inches, weighing between 2 and 3 lbs. each. These sheets are then corrugated and packed in crates with plates of coke or carbon which form the negative electrodes. Strips of tin make the connection between the lead or electro-positive plate and the carbon electrode, the object being that when subjected to warm vapours of acetic acid, carbonic acid, and atmospheric

air, electrical action is set up between the two, which hastens the corrosion and reduces the time required to convert the plates into carbonate of lead from 10 to 15 weeks (the time required by the old Dutch process) to five weeks. The corroded plates are subjected to a similar process as that already described under the head of the Dutch process.

Another electrolytic process consists in electrolysing a 10 per cent. solution of sodium nitrate in a wooden cell provided with a porous diaphragm, the anode being made of pig lead, and the cathode of copper. In the former compartments the lead dissolves as nitrate, whilst round the cathode caustic soda is produced. The two solutions being drawn off and mixed, the alkaline nitrate is regenerated, and the lead precipitated as hydrate. The hydrate is finally treated with sodium carbonate or bicarbonate to convert it into white lead. The caustic soda formed as a bye-product in the latter operation has only to be recarbonated to be available again.

A somewhat similar process, patented by Mr. Browne, is carried out by placing metallic lead in a suitable vessel in electric connection with the positive pole in the presence of a solution of an acetate or a nitrate of an alkali base. A soluble salt of lead is formed on the anode and a solution of caustic alkali at the cathode. In consequence of the flow of the electrolyte against the cathode these two solutions intermix, with the result that lead hydrate is precipitated, the original alkaline salt being regenerated. The solution containing the lead hydroxide in suspension is then run into a settling tank, from which the clear solution is subsequently drawn off when it is used again as the electrolyte, and the lead hydrate is finally exposed to the air or to an atmosphere of carbonic acid to convert it into hydrated carbonate of lead.

It is to be observed that in reality electrolysis plays but little part in these processes, but the mixture of lead carbonate and hydrate of which white lead consists is purely by chemical means.

Another process patented in America consists in passing an electric current from an anode of metallic lead through an alkaline electrolyte consisting of a solution of a salt of ammonia in combination with any acid which will produce a soluble lead salt (including sulphuric acid) and of a bicarbonate of an alkali to a cathode of lead, carbon or other suitable material, thereby causing a decomposition of the salts in the electrolyte, and a formation of a soluble compound of lead, which is transformed into the hydrated carbonate of lead by the simultaneous generation of free carbonic acid at the anode by the presence of caustic alkali (ammonia) generated at the cathode, passing a current of carbonic acid gas through the electrolyte to regenerate the spent alkaline carbonate until the anode is completely dissolved. Both the acetate and bicarbonate of soda are continuously regenerated, the process consuming only lead, carbonic acid and water.

An English process, which has lately been protected, consists in decomposing acetate of ammonia by electrolysis, lead anodes being used, which are separated by porous diaphragms which are made preferably of stout Willesden paper, which are insulated from the bottom to prevent irregular electrolytic action in the electrolyser. A lead solution is produced, and caustic alkali, when on mixing the two solutions white lead is precipitated. When a series of cells are used, the exit openings at the bottom are closed by elastic bags, which are distended by the fluid within.

In another process patented in Germany, lead anodes 3 mm. in thickness are employed for the electrolysis of a solution containing 300 cc. nitric acid and 2,000 cc. of water. The lead salt formed is precipitated as white lead, and gives off a stream of carbonic acid gas. Any silver contained in the lead is deposited on the cathodes, and can be recovered.

## NEW PATENTS.

*[Compiled expressly for this journal by* W. P. Thompson & Co., *Electrical Patent Agents, 322, High Holborn, London, W.C., to whom all inquiries should be addressed.]*

1,835. "An improved telegraph cable grip." A. Gray. Dated January 24th.

1,869. "Improvements in insulators." E. Renault. Dated January 24th. (*Complete.*)

1,872. "Curve tracer of electrical measurements." W. Douglas. (E. Rosa, United States.) Dated January 24th. (*Complete.*)

1,880. "Improvements in electric pendulum indicators." F. Jones. Dated January 24th.

1,887. "Method of and means for enabling code or cypher printing or signalling to be effected by means of the ordinary keyboards of type-writing machines, telegraphic apparatus, type-composing machines, or the like." J. Ballot. Dated January 24th.

1,912. "Improvements in telephones." J. D. F. Andrews. Dated January 24th.

1,923. "Improvements in dynamo-electric machinery." J. S. Lewis and F. J. Howitt. Dated January 24th.

1,970. "An improved electric switch or contact maker." J. G. Dixon. Dated January 25th.

1,994. "Improvements in safety fuses for electrical conductors." L. A. Ferguson. Dated January 25th. (*Complete.*)

2,007. "Improvements in or relating to transmitting electrical impulses and signals." E. Wilson and C. J. Evans. Dated January 25th.

2,021. "Electrical log recording instrument for the cabin." P. Jensen. (Patentaktiebolaget Svea, Sweden.) Dated January 25th.

2,024. "Improvements in and relating to primary batteries." C. Koenig. Dated January 25th. (*Complete.*)

2,025. "Improvements in rheostats for regulating the current used in electro-plating and other processes." W. P. Thompson. (The Zucker & Levett and Loeb Company, United States.) Dated January 25th.

2,030. "Improvements in primary batteries." E. Giglio. Dated January 25th.

2,039. "An improved relay switch." T. B. Browne and J. M. James. Dated January 26th.

2,040. "An electrical fire call telegraph." W. Blenheim. Dated January 26th.

2,063. "Improvements in switches for electric light service." A. E. Tanner. Dated January 26th.

2,106. "An improvement in, and connected with, electric arc lamps." J. O. Girdlestone and C. F. G. Thorkelin. Dated January 26th.

2,167. "Improvements in, and connected with, electric generators for cycles and other vehicles." J. Moores and H. O. Farrell. Dated January 27th.

2,171. "An electric bell piano." S. J. Godwin. Dated January 27th.

2,172. "Improvements in attachments to electric incandescence lamps." C. H. Stearn. Dated January 27th.

2,215. "Improvements in, and connected with, the generating of electricity through the motion of the rolling stock and the like." M. Clark and J. B. de Atzugaray. Dated January 27th.

2,266. "Improvements relating to electric plating." J. Matthews and T. Vann. Dated January 28th.

2,284. "A new application of the electric incandescent lamp." J. R. Payne. Dated January 28th.

2,292. "Improved insulator for telegraph wires and the like." H. Peters. Dated January 28th.

2,299. "Improvements in joints between the glass globes of electric arc lamps and the supports by which they are carried." P. H. Guerin. Dated January 28th.

2,308. "Improvements in electrical advertising apparatus." P. C. Pope and J. F. Simpson. Dated January 28th.

2,375. "A teletypograph for transmitting, receiving, and recording messages through a telegraph wire electrically." J. Campbell. Dated January 29th.

2,382. "Improvements in, or relating to, electric telegraphy." P. Picard. Dated January 29th.

2,389. "Improvements in secondary batteries." J. V. Sherrin. Dated January 29th.

2,415. "Improvements in methods or processes for electro-thermally treating materials, and particularly with reference to the manufacture of calcium carbide and apparatus therefor." H. Maxim and W. H. Graham. Dated January 29th.

2,417. "Automatic electric circuit breakers." M. Bouchet. (Date applied for under Patents, &c., Act, 1883, Sec. 103, July 2nd, 1897, being date of application in France.) Dated January 29th.

2,420. "Improved means for controlling the working of lifts, motors and other appliances operated by electric energy." W. A. Ker. Dated January 29th.

2,423. "Improvements in the manufacture of filaments for incandescent electric lamps." R. Mullard. Dated January 29th.

2,426. "An improved method of and means for facilitating the starting of single or polyphase alternating current motors and the like apparatus." M. Déri. Dated January 29th. (*Complete.*)

2,427. "Improvements in variable electric resistances or rheostats." R. Waygood & Co., Ltd., and P. I. Unwin. Dated January 29th.

2,428. "An improved electrical transformer for currents of high potential and variable frequency." A. Wydts and O. M. Rochefort. Dated January 29th.